

THE GROWING PHENOMENON OF SCHOOL GARDENS:  
CULTIVATING POSITIVE YOUTH DEVELOPMENT

By

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By

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## **DEDICATION**

I dedicate this dissertation to the schoolteachers in this study and throughout the United States who use school gardens. Many of these teachers use school gardens with the belief and knowledge that these gardens may enhance the education and development of their students. It is through their efforts that this research was possible. May their gardens and students continue to grow and flourish.

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Abstract of Thesis Presented to the Graduate School  
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Several youth development theories (cognitive, social cognitive, and ecological) provided the theoretical framework for a study of school gardens and their impact on youth. A teacher questionnaire was developed to gain insight into how teachers use school gardens with their students and in their curriculum. The information gathered from 28 third-grade teachers was used to develop a multi-level framework that would serve as the independent variable of analysis. Elements of positive youth development (responsibility and attitudes towards science, the environment, and the garden) of 427 third-grade students were investigated. These elements were examined in relation to school garden intensity and form.

Descriptive statistics showed that teachers were using school gardens in many different ways and to varying degrees. This variation among gardens was simplified into a multi-level framework based on intensity, measured by the number of garden-related activities students participated in prior to and while in the garden (high,

medium, and low) and the form of school gardens (flower, vegetable, or combination flower/vegetable). This typology consisted of nine types of gardens: (a) low-intensity flower garden, (b) low-intensity vegetable garden, (c) low-intensity combination garden, (d) medium-intensity vegetable garden, (e) medium-intensity flower garden, (f) medium-intensity combination garden, (g) high-intensity vegetable garden, (h) high-intensity flower garden, and (i) high-intensity combination garden. Analysis of covariance was to determine if there were significant differences among the nine types of school gardens. Significant differences were found among the school garden types and students' attitudes toward science, attitudes toward the usefulness of science study, and attitudes toward gardens. While there were no significant differences among school garden types and students' responsibility scores and environmental attitudes, scores for each of these elements were very high (indicating a sense of responsibility and a positive environmental attitude) with little variation.

## CHAPTER 1 INTRODUCTION

"A garden is a wonderfully interesting and exciting place in which children can play, work, and learn" (Herd 1997, p. 6). Many teachers throughout America who praise the wonders and benefits of school gardens are echoing this statement. Schools and teachers have been using gardens to teach their students since the 1800s. Throughout the past 200 years, school gardening has been championed by many teachers who believe school gardens provide the best way to enhance classroom lessons (Becker, 1995; Berghorn, 1988; Braun, 1989; Canaris, 1995; Gwynn, 1988; In Virginia, 1992; Neer, 1990; Stetson, 1991). Even today the practice is becoming more widespread. Currently, every one of the 8,000 public schools in the state of California either has a school garden, has one being installed, or has plans to install a garden (Peyser & Weingarten, 1998). Obviously, many educators are realizing the value and benefit of gardens to their school and students. Gardens provide an environment in which students can learn to work with teachers, parents, and volunteers while growing plants and discovering the relationships among people, plants, and wildlife (Alexander, North, & Hendren, 1995).

The first educational gardens were found in Europe as early as 1525 AD. One of the first proponents of the school garden was Fredrick Froebel who founded the first *kindergarten* in 1840. Froebel's kindergarten, which translated means child garden, was designed so that students could learn through light gardening (Bachert,

1976). School gardens in America have existed since the late 1800s. At first, the idea of gardening at school was slow to catch on, with only five known gardens before 1900. This number rose dramatically over the next decade with 80,000 reported school gardens by 1910.

One of the first educators to document the benefits of school gardening was Maria Montessori. Montessori (1912) believed that children working in a garden would learn moral education and an appreciation of nature. Montessori noted that gardens benefited children in several ways. Children developed a sense of responsibility by caring for plants and learned patience by waiting for plants to grow. She also reported that interpersonal skills improved after working in the garden.

During the 20<sup>th</sup> century, school gardens have grown in popularity and many schools are now using gardens to supplement their lessons. One study conducted found that students who were taught in school gardens and vegetated areas of school grounds had higher scores for general botanical knowledge than students who received instruction with little or no vegetation at their school (Harvey, 1989). Additionally, many studies have found that involvement in outdoor activities, including gardening, can have positive effects on children's environmental attitudes, making them more environmentally conscious (Harvey, 1989; Skelly, 1997).

Interest in school gardens is not limited to the United States. Many elementary and junior high schools in Japan regularly participate in agricultural activities. Japanese schools have farms directly on school property or in close proximity. Farming and gardening practices are being used in 70 to 80% of primary schools and in 40 to 50% of secondary schools. The students grow a variety of

vegetables and view the garden as a fun activity (Konoshima, 1995). Konoshima found that these agricultural activities led students to a better appreciation and understanding of nature. In addition, Konoshima remarks that farming activities give students a heightened sense of self-control and a better discernment of work.

Similarly, a classroom garden program in San Antonio, Texas, reported that second- and third-grade students who participated in gardening once a week gained beneficial results after participating in the program. After conducting interviews with teachers, parents, and students, researchers reported that the garden project gave students the opportunity to learn about "delayed gratification, independence, cooperation, self-esteem, enthusiasm/anticipation, nurturing living things, motivation, pride in their activities, and exposure to role models from different walks of life" (Alexander et al., 1995, p. 259). Additionally, researchers reported that parental involvement and enthusiasm increased as children participated in the garden; many teachers stated that children convinced their parents to grow gardens at home. Children also were found to have a greater sense of community as they worked in their gardens at school and at home. The garden is a hands-on educational tool. After interviewing the involved teachers, researchers reported that the garden can be related to all subjects and "puts it in a way the kids are able to understand" (Alexander et al., 1995, p. 259).

One reason students may learn better through school gardens is that working in a garden and with nature may require "involuntary attention" (Kaplan, 1973, p. 146). Kaplan states that people report being fascinated with nature and specifically gardening because of the intrigue of growing things. It is such fascination that leads

to involuntary attention, an effortless non-competing mind set. Kaplan argues that if gardening can result in involuntary attention, benefits are likely. Benefits can include a rest for the mind from effort due to constant attention as well as a rest from competing thoughts of worries and cares.

Teachers have been using school gardens for a number of reasons, for example, students' learning was made more meaningful by garden lessons (Canaris, 1995; Kutsunai, 1994; Levenston, 1988). Educators also reported that students are involved in prediction making and inquiry-based learning through gardening activities. Teamwork, nurturing, caring for something other than themselves and seeing the product of these life skills are other anecdotal benefits students derive from the garden (Canaris, 1995). School gardens also lend themselves as instructional tools for all subjects such as reading, art, music, and social studies, going beyond the traditional math and science lessons a garden typically offers (Canaris, 1995; Eames-Sheavly, 1994; Levenston, 1988). Skelly and Bradley (2000) in a study with Florida elementary school teachers, found that 97% of the thirty-five teachers surveyed used their gardens to teach environmental education. Eighty-four percent of these teachers agreed that their school garden helped students learn better. Experiential learning was cited by about three quarters of the teachers as an additional reason they used the school garden. In contrast to the positive reports of school gardens, one study found no differences among attitudes toward school, interpersonal relationships and self-esteem levels of students participating in gardening programs and students not participating in gardening programs (Waliczek, 1997). Waliczek also found that different types of gardening programs had different affects on students' school

attitudes. The research proposed in this study intends to continue to look at different types of school gardening programs and their affect on students.

The benefits of school gardens in promoting positive youth development have been minimally addressed through scientific research. Researching the role school gardens may have on the cognitive and social development of students has also received very little attention. In the past, research on school gardens has focused on teachers' uses of school gardens (DeMarco, 1999; Skelly & Bradley, 2000), impact on environmental attitudes (Skelly, 1997; Waliczek, 1997), knowledge (Waliczek, 1997) and nutrition (Lineberger & Zajicek, 2000). To date, variables related to positive youth development (possession of youth developmental assets, positive attitudes toward science, and positive attitudes toward the environment) have not been examined in the context of school gardens.

### **Purpose of the Study**

Studies concerning the benefits and effects of school gardens on students are limited. Previous studies explored differences among students participating in garden programs and students not participating in garden programs. Although these research endeavors shed light on some of the benefits students gain from school gardens, there has not been a research study that examines how teachers are currently using school gardens. The initial goal of this study was to determine how teachers are using school gardens and what, if any, type of variation in use. Knowledge of how teachers use school gardens, and the different approaches that may exist is important information for developing a model that explains differences among students. An additional

purpose of this study was to explore the impact of school garden variation on elements of positive youth development.

Specifically, this study was designed to accomplish the following purposes:

1. Determine how teachers use school gardens with their students and within their curriculum, and if variation exists in the uses of school gardens.
2. Determine the factor(s) that contribute to the intensity of a school garden program.
3. Develop a multi-level framework that incorporates both school garden intensity and school garden form (flower, vegetable, or combination flower/vegetable) to explore elements of positive youth development: youth developmental assets (achievement motivation, school engagement, responsibility, and interpersonal competence) and students' attitudes toward science, the environment, and the school garden.
4. Adapt existing measures, or develop new measures, to enable the study of school gardens.
5. Provide theoretical and empirical support that will assist with the design and use of school gardens for elementary-age children.

### **Definitions**

The key concepts used in this study are defined below.

**Cognitive development.** Development is defined by Good and Brophy (1995, p. 29) as "an orderly progression to increasingly higher levels of both differentiation and integration of the components of a system." Cognitive

development therefore refers to the development of cognition or “the act or process of knowing” (Woolf, 1981, p. 215).

**Youth developmental assets.** While there are many ways to assess youth development, for the purposes of this study, the focus will be on certain developmental assets, or the “positive relationships, opportunities, skills, and values that help young people grow up healthy” (Scales & Leffert, 1999, p. 1).

**Achievement motivation.** Achievement motivation is a developmental asset addressing a young person’s motivation to do well in school.

**School engagement.** Scales and Leffert (1999, p. 122) define this developmental asset as the “feeling of connectedness to school.”

**Responsibility.** Responsibility is a developmental asset that children develop when they learn to accept and take personal accountability (Benson et al., 1997).

**Interpersonal competence.** Interpersonal competence refers to the developmental asset addressing a child’s ability to interact with adults and peers as well as to make friends.

**Science attitudes.** Science attitudes refers to students’ attitudes toward their science teacher, science class, usefulness of science study, and being a scientist (Yager & Yager, 1985).

**Environmental attitudes.** Environmental attitudes refers to students’ attitudes toward the environment, environmental policies, and environmental issues.

**Garden attitudes.** Garden attitudes refers to students’ attitudes toward the school garden they use and the activities associated with the garden.

**School garden.** A school garden is a piece of school property where plants are grown and horticulture is practiced as an educational strategy and learning tool (DeMarco, 1999).

**School garden form.** The form of the garden refers to the types of plants grown in the garden. In this study three forms were observed: vegetable garden (a garden that contains only vegetable plants), flower garden (a garden that contains only flowering or ornamental plants), and a combination vegetable/flower garden (a garden containing both vegetable and flowering or ornamental plants).

**School garden intensity.** School garden intensity is the level at which teachers and students design, use, and integrate a school garden. Factors determining intensity include, but are not limited to: amount of time students spend in the garden, activities students participate in while in the garden, percentage of time that the teacher uses the garden as an instructional tool in the classroom, and number and type of subject areas into which school gardening has been incorporated.

**School garden type.** School garden type is a concept created by combining school garden form (flower, vegetable, combination flower/vegetable) and school garden intensity (high, medium, and low).

**Sunshine State Standards.** The Sunshine State Standards are the Florida Department of Education's list of educational standards that teachers are to address for each grade level (Florida Department of Education, 2000).

### Research Questions and Hypotheses

The following research questions and related hypotheses were examined in this study. Hypotheses were advanced when previous research was sufficient to indicate a relationship. The remaining research questions were considered exploratory and therefore no hypotheses were developed.

#### Research Question 1

- 1.1 How and to what degree are teachers using school gardens?
- 1.2 What factors contribute to the intensity of a school garden program?
- 1.3 Do school gardens vary in intensity and form?

#### Research Question 2

- 2.1 Do students using school gardens possess the youth developmental assets of achievement motivation, school engagement, responsibility, and interpersonal competence?
- 2.2 Do students possess the youth developmental assets of achievement motivation, school engagement, responsibility, and interpersonal competence in varying degrees depending on school garden type?

**Hypothesis:** There is a positive relationship between the number of youth developmental assets students possess and school garden type.

**Research Question 3**

- 3.1 In what ways do students' attitudes toward science differ depending on school garden type?
- 3.2 In what ways do students' attitudes toward science differ based on a variety of personal and social context variables?

**Hypothesis:** Students' attitudes toward science do not differ by gender in the third grade.

**Hypothesis:** There is a positive relationship between students' attitudes toward science and school garden type.

**Research Question 4**

- 4.1 In what ways do students' attitudes toward the environment differ depending on school garden type?
- 4.2 In what ways do students' attitudes toward the environment differ based on a variety of personal and social context variables?

**Hypothesis:** Students' attitudes toward the environment do not differ by gender in the third grade.

**Hypothesis:** There is a positive relationship between students' attitudes toward the environment and school garden type.

**Research Question 5**

- 5.1 In what ways do students' attitudes toward school gardens differ depending on school garden type?

## Theory

Typically, a school garden may be viewed as a teaching technique and not a place where cognitive and social-cognitive development occurs. However, as many teachers anecdotally point out, the school garden is a place that enhances learning, promotes cooperation, and teaches children responsibility (Anon, 1992; Becker, 1995; Berghorn, 1988; Braun, 1989; Canaris, 1995; Davies, 1995; Gwynn, 1988; Neer, 1990; Stetson, 1991). These benefits can be interpreted as manifestations of children's cognitive and social-cognitive development. Additionally, many teachers use and promote gardening as the ideal forum for experiential learning (Anon, 1992; Barron, 1993; Craig, 1997; Kutsunai, 1994). While such anecdotal evidence is important for recognizing the possible benefits school gardens may hold for students, it is first important to have an understanding of the theories that underlie cognitive and social-cognitive development and experiential learning. Within the framework of educational psychology, "the study of thoughts and actions that are related to how we teach and learn" (Gage & Berliner, 1988, p. 3), are several theories that focus specifically on the cognitive development of children. Development is defined by Good and Brophy (1995, p. 29) as "an orderly progression to increasingly higher levels of both differentiation and integration of the components of a system." Cognitive development therefore refers to the development of cognition or "the act or process of knowing" (Woolf, 1981, p. 215). The following combination of cognitive development, social-cognitive development, human ecological and experiential learning theories has the potential to enhance future studies in the area of school gardens.

The following sections outline the predominant and pertinent theories of cognitive development, social-cognitive development, human ecological development, and experiential learning. How these theories are related and how they pertain to a study of school gardens also is addressed.

### **Theories of Cognitive Development**

#### **Piaget's theory of cognitive development**

Jean Piaget introduced the first theory of cognitive development. The premise of Piaget's theory is that "children actively construct their own knowledge of the environment using what they already know to interpret new events and objects" (Meece, 1997, p. 118). This theory is the basis for constructivism, or the idea that children construct their knowledge from experience with the environment around them. Additionally, Piaget postulated that development occurs through a series of stages that humans pass through as they grow older. Piaget reasoned that as humans try to make sense of the world, the thinking processes change radically and become more complex from birth to maturity. Piaget defined three influences on cognitive development; maturity through biological changes, ability to act on and learn from the environment through social transmission or interaction with others, and equilibration (Meece, 1997; Woolfork, 1998).

Piaget's theory of cognitive development also characterized two tendencies in thinking. The first tendency is to organize, combine, arrange, recombine and rearrange thoughts into congruous systems. These systems are arranged into schemes or "cognitive, verbal, and behavioral frameworks that are developed to organize

learning and to guide behavior" (Good & Brophy, 1995, p. 33). Another tendency is adaptation or adjustment to the environment. Our ability to adapt is based on two processes that occur simultaneously. The first process is assimilation, which allows people to use existing schemes to make sense of the world. The second process is accommodation. Accommodation requires a person to assess a new situation or information and to determine if it fits into an existing theme. If the new situation or information does not fit, accommodation allows people to change a scheme or develop a more appropriate scheme so that the new information will fit. Cognitive development occurs because of a person's ability to integrate new information into existing schemes or by the construction of new schemes. Piaget reasoned further that in order for human beings to maintain a balance between accommodation and assimilation, people must maintain equilibrium between the two. This idea of equilibrium is one of Piaget's fundamental assumptions; "people strive for equilibration as they impose order and meaningfulness on their experiences" (Good & Brophy, 1995, p. 4).

Piaget's theory rests on the process of cognitive development through scheme construction and on the stages during which schemes develop. Piaget defined four stages of cognitive development: sensorimotor, preoperational, concrete operations, and formal operations (Table 1-1). Each stage represents an increasingly complex level of cognitive development from birth to adulthood. According to Piaget, children proceed through these stages in the same sequence; it is not possible to skip a stage, nor is it possible to revert to a previous stage. Piaget defined age ranges for

each group, although he recognized that these ranges are general and may be affected by individual and cultural factors (Meece, 1997).

**Table 1-1. Piaget's stages of cognitive development.**

Stage	Age	Characteristics
Sensorimotor	Birth to 2 years	<ul style="list-style-type: none"> <li>• Move from reflexive behavior to goal-directed behavior</li> <li>• Means: end thinking</li> <li>• Object permanence: objects continue to exist even when they are not in sight</li> </ul>
Preoperational	2 to 7 years	<ul style="list-style-type: none"> <li>• Language development</li> <li>• Ability to think and solve problems intuitively, through symbols</li> <li>• Thinking is rigid, centered, and egocentric</li> </ul>
Concrete operations	7 to 12 years	<ul style="list-style-type: none"> <li>• Ability to think logically due to attainment of seriation, classification, conservation, negation, reversible thinking, identity, and compensation</li> <li>• Able to solve hands-on, concrete problems logically</li> <li>• Adopt another's perspective</li> <li>• Consider intentions in moral reasoning</li> </ul>
Formal operations	12 years and beyond	<ul style="list-style-type: none"> <li>• Hypothetical and purely symbolic (complex verbal) thinking</li> <li>• Development of abstract systems of thought</li> <li>• More scientific thinking that allows the use of propositional logic, scientific reasoning, and proportional reasoning</li> <li>• Concerns over identity and social issues</li> </ul>

Adapted from Good & Brophy (1995, p. 37) and Meece (1997, p. 119)

The first of Piaget's stages is the sensorimotor stage, which occurs from birth to two years. During this stage children acquire the schemes of goal-directed behavior and object permanence. According to Piaget, these schemes provide the foundation for symbolic thinking and human intelligence (Meece, 1997). The next stage of cognitive development is the preoperational stage occurring from age 2 to 7. Children in the preoperational stage are beginning to think about objects, people, and/or events even when they are absent. Their ability to use symbols – gestures,

words, numbers, and images – as representations of their environment is a major accomplishment of the preoperational stage. This ability increases as the child moves through this stage, but remains limiting as children lack the ability to perform logical operations (Meece, 1997; Woolfork, 1998).

The third stage of cognitive development is the concrete operational stage, occurring from age 7 to 12, and is characterized by a child's ability to solve concrete or hands-on problems in a logical fashion. Children in this stage also are able to understand the laws of conservation, classification, seriation, and reversibility (Good & Brophy, 1995; Woolfork, 1998). Children in this stage of development are also less centrated and egocentric. At this stage of development, children's thinking becomes less rigid and more flexible and children are no longer basing their judgements on the appearance of things (Meece, 1997).

For the purposes of this study, children ages 9 to 10 were the subjects under investigation, therefore a more thorough discussion of the concrete operational stage follows. A key feature of the concrete operational stage is the ability of children to understand the laws of conservation, reversibility, classification, and seriation. Conservation reasoning is one of the hallmarks of the concrete operational stage. "Conservation involves the understanding that an entity remains the same despite superficial changes in its form or physical appearance" (Meece, 1997, p. 133). This ties in to children's ability to base their reasoning, not on physical appearance, but on an understanding of identity. Understanding identity means that children realize that a material remains the same if nothing is taken away or if nothing is added. Additionally children begin to understand reversibility, or the knowledge that a

change in one direction can be compensated by a change in another direction (Woolfork, 1998).

Another premise of the concrete operational stage is the child's ability to accomplish reversible thinking. Reversible thinking allows a child to classify objects in more than one dimension due to their ability to reverse an operation. For example, a child may first classify an object based on color and then reclassify it based on shape. This ability to recognize multiple dimensions allows children in the concrete operational stage to acquire advanced classification skills. The ability to classify was believed by Piaget to be central to this stage. While children in the preoperational stage have the ability to classify, it is usually limited to one dimension, such as shape or color. Children in the concrete operational stage begin to recognize that objects have more than one dimension and are able to classify based on hierarchical order (Berk, 2000). Classification skills allow children to impose order on their environment by organizing objects according to similar elements. The final hallmark of Piaget's concrete operational stage is the child's ability to order object in a logical progression or seriation. Seriation is a necessary skill for understanding numbers, time, and measurement (Meece, 1997).

The concrete operational child's ability to conserve, reverse, classify, and seriate objects allows for a logical system of thinking. This logical thinking, however is still tied to the physical reality and is based on concrete situations that can be organized, classified, or manipulated. While children in this stage of cognitive development are capable of higher orders of thinking, they are not yet able to reason about hypothetical or abstract problems (Woolfork, 1998).

The final stage of cognitive development is the formal operational stage from 11 to 12 years and onward. Emerging from the concrete operational stage, older children have acquired the skills and mental operations they will need to begin more elaborate systems of logical and abstract thinking. During this stage, children's thinking progresses from what is – reality, to what might be – the possible. These students can think about things they may never have experienced, generate ideas about what might have happened, and make predictions about what may happen in the future. Key elements of the formal operations stage are that students are able to think hypothetically and symbolically, to develop abstract systems of thought, to use scientific reasoning, and to reason hypothetico-deductively (Meece, 1997). Children and adolescents develop these attributes of formal operations over time and some psychologists debate whether all adults reach the formal operational stage (Woolfork, 1998). Neimark (1975) contends that

the first three stages of Piaget's theory are forced on most people by physical realities. Formal operations, however, are not so closely tied to the physical environment. They may be the product of experience and of practice in solving hypothetical problems and using formal scientific reasoning. These abilities tend to be valued and taught in literate cultures, particularly in colleges and universities. (Woolfork, 1998, p. 38)

In regards to educational practices, Piaget's theory helps define some recommended practices for the classroom. Much of what Piaget theorized falls in line with current constructivists' views on teaching and learning. The underlying assumption of constructivism is that children construct their own understandings of the world in which they live. Children cannot simply have knowledge transmitted to them; they must act on the knowledge by manipulating and transforming it so that it makes sense to them. The National Council for Teachers of Mathematics and the

National Science Teachers Association have called for “classrooms where problem solving, ‘hands-on’ experimentation, concept development, logical reasoning, and authentic learning are emphasized” (Meece, 1997, p. 117). As an example of how Piaget’s theory applies to the classroom, Table 1-2 provides a list of guidelines set forth by the National Association for the Education of Young Children (NAEYC, 1987) for teaching and learning.

**Table 1-2. National Association For The Education Of Young Children’s Guidelines For Teaching And Learning.**

Appropriate Practices
<ul style="list-style-type: none"> <li>• Teachers prepare learning environments for children to learn through active exploration and interaction with adults, other children, and materials.</li> <li>• Children are expected to be physically and mentally active. Teachers recognize that children learn from self-directed problem solving and experimentation.</li> <li>• Children are provided concrete learning activities with materials and content relevant to their lives.</li> <li>• Children select many of their own activities from a variety of learning areas, including dramatic play, blocks, science, math games and puzzles, art, and music.</li> <li>• Teachers move around groups and individuals to facilitate children’s involvement with materials and activities.</li> <li>• Teachers accept that there is often more than one right answer. Teachers focus on how children justify and explain their answers.</li> </ul>
Inappropriate Practices
<ul style="list-style-type: none"> <li>• Teachers use highly structured, teacher-directed lessons.</li> <li>• Teachers direct all the activities, deciding what children will do and when. Teachers do the activity for the child.</li> <li>• A major portion of children’s learning time is spent passively listening, sitting, and waiting.</li> <li>• Large-group, teacher-directed instruction is used most of the time.</li> <li>• Workbooks, ditto sheets, flashcards, and other similarly structured abstract materials dominate the curriculum.</li> <li>• Teachers dominate the instructional process by talking, telling, and showing.</li> <li>• Children are expected to respond correctly with one right answer. Rote memorization is emphasized.</li> </ul>

Source: ©Meece, 1997, p. 149. Reprinted with permission.

Piaget’s theory provides a basis for understanding how children’s thinking and learning develop as they grow. There are, however, problems with Piaget’s theory. Contemporary theorists have questioned the age categories Piaget assigned to the stages of development. These theorists contend that Piaget underestimated the ability of younger children. Additionally, Piaget also received criticism for not considering

the social and cultural contexts within which children grow and develop as a factor in cognitive development (Meece, 1997). However, many educational psychologists regard Piaget's theory as theoretical rationale for constructivist, discovery, inquiry, and problem-solving teaching practices that are used in classrooms today (Meece, 1997).

Other theories concerning cognitive development have emerged and are just as important when trying to understand how cognitive development occurs. While Piaget's theory of cognitive development helps us understand how children reason and think about the world, Lev Vygotsky's sociocultural theory and Albert Bandura's social cognitive theory of development help us understand the social processes that influence the development of intellectual abilities in children.

### **Vygotsky's sociocultural theory and Bandura's social cognitive development theory**

Vygotsky's theory focuses on the social relationships of children and how these relationships affect their cognitive development. The foundation of Vygotsky's theory lies in his assertion that it is cultural institutions and social activities, not innate factors that shape an individual's thinking patterns. Vygotsky's theory is founded on his belief that cognitive development occurs as children internalize the products of their social interactions (Meece, 1997).

Vygotsky contended that children are born with certain innate abilities such as perception, attention, and memory, and by interacting with more knowledgeable adults these abilities are shaped into higher mental functions. He believed that

children internalize these functions and this internalization of physical actions and/or mental operations results in cognitive development (Meece, 1997).

Much of Vygotsky's theory is based on the role of language and symbolic thought in a child's cognitive development. He believed that language and manifestations of language – books, numbers and mathematical systems, signs, and so forth play a very important role in the development of children. Language is a means for expressing one's ideas, asking questions, linking the past and the future, and applying order to one's environment (Woolfork, 1998). Language, through various stages of speech, provides the basis for development. Social speech is the first stage of language and is used primarily for communicating. The next stage of language and thought is egocentric speech, which children use to regulate their behavior and thinking. Egocentric speech is sometimes referred to as private speech as children speak out loud to themselves to help them perform tasks. The final stage of speech development is inner speech, where children internalize their egocentric or private speech (Meece, 1997; Woolfork, 1998).

One of the most important constructs set forth by Vygotsky is the zone of proximal development. The zone of proximal development deals with a child's potential for growth rather than their actual growth. Vygotsky defined the zone of proximal development as

those functions that have not yet matured but are in the process of maturation, functions that will mature tomorrow but are currently in an embryonic state. These functions could be termed the 'buds' or 'flowers' of development rather than the 'fruits' of development. The actual development level characterizes mental development retrospectively, while the zone of proximal development characterizes mental development prospectively. (Meece, 1997, p. 154)

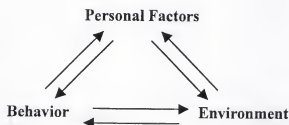
In terms of education, instruction should precede development and awaken those functions that are in the process of maturing. Vygotsky argued that for a child to develop fully, the child should take part in progressively more complex levels of functioning. This idea of leading children into more complex levels of function is known as intellectual scaffolding (Gage & Berliner, 1988).

Scaffolding is based on the idea that adults help guide children's intellectual development. The goal of scaffolding is to shift responsibility for a task from the adult to the child. This is accomplished by the adult providing support to the child by performing or directing elements of the task that are beyond the child's ability (Meece, 1997).

In addition to the role of the adult in Vygotsky's theory, is the role of a child's peers. Peers can influence development when they say something that is in conflict with what the child thinks. From a Piagetian perspective, when conflict arises, it is necessary for the child to accommodate or assimilate the new information and regain equilibrium. Within the framework of Vygotsky's theory, peer influence on development occurs through collaborative problem solving among children. Vygotsky's theory of cognitive development shifts the emphasis of development from the child (Piaget) to the adult and peers. While these theories of learning are thought to be accurate, contemporary theorists such as Albert Bandura feel they are incomplete. To further the theories of learning and cognitive development, Bandura proposes a social-cognitive theory (Bandura, 1986; Woolfork, 1998).

Bandura (1986, p. 483) states that "most cognitive skills and structures used in daily pursuits are cultivated socially, rather than asocially." According to Bandura,

the social cognitive view of development is that neither innate abilities nor external stimuli drive development, rather development is explained by the notion of triadic reciprocity. Triadic reciprocity explains development as the result of behavior (individual actions, choices, and verbal statements), personal factors (beliefs, expectations, attitudes, and knowledge), and environmental events (resources, consequences of actions, and physical setting) all interacting and influencing each other (Bandura, 1986; Woolfork, 1998, p. 225) (Figure 1-1). This interaction of elements is referred to as reciprocal determinism.



**Figure 1-1. Triadic reciprocity: Relationship of person and environment as viewed by social cognitive theory.**

*Source:* ©Bandura, 1997, p. 6. Reprinted with permission.

Bandura's social cognitive theory also explains two types of learning, enactive and vicarious learning. Enactive learning is achieved by doing and experiencing the consequences of one's own actions. Experiencing these consequences is what allows a person to learn about "appropriate actions, creating expectations, and influencing motivation" (Woolfork, 1998, p. 225). Contrary to enactive learning is vicarious learning, or learning by observation. Vicarious learning is accomplished when people model and imitate others. According to Bandura, other cognitive theories overlook

the power of vicarious learning as people can learn “by watching, [because] they must be focusing their attention, constructing images, remembering, analyzing, and making decisions that affect learning” (Woolfork, 1998, p. 225).

In essence, Bandura’s theory emphasizes the importance of the interaction between the person and environment in cognitive development. Bandura (1986) believes that learning is mediated through five capabilities:

- a) the capacity to learn by observation (i.e, through behavior that is modeled),
- b) the capacity to manipulate information symbolically, c) the capacity for forethought (i.e, people are able to anticipate the likely effects of different events and regulate their behavior accordingly), d) the capacity for self-reflection, and e) the capacity for self-regulation (i.e, adjusting one’s thoughts, feelings, and actions based on an evaluation of their outcomes) (Ferrari, 1998, p. 25).

This focus on learning based on interactions among the person, behavior, and the environment is also a key element in the human ecological theory developed by Bronfenbrenner. The ecological theory of human development provides a perspective of development that “reveals connections that might otherwise go unnoticed and helps us to look beyond the immediate and obvious to see where the most significant influences lie” (Garbarino, 1982, p. 18).

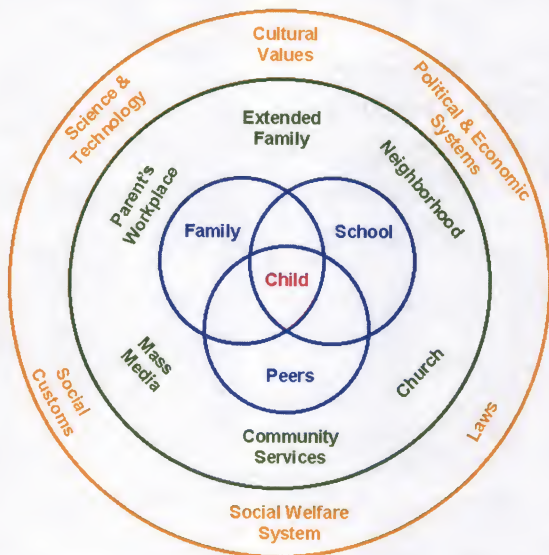
### **Bronfenbrenner’s Ecology of Human Development**

Another important theory for understanding how children develop is the human ecological model developed by Bronfenbrenner (1979). In the ecological model, human development is a constant, evolving process of interactions between humans and the environment. Bronfenbrenner viewed the environment as a

contextual model with multiple structures that are nested and interconnected with the child at the center of the model (Figure 1-2).

Bronfenbrenner theorized that the child, who is born with certain temperamental, mental, and physical conditions that dictate his biological development, does not develop in a vacuum (Meece, 1997). Rather, there are certain contexts that impact his development, such as family, peers, and school. These immediate contexts are known as microsystems (blue) because they require the child's participation and interaction and therefore have a significant impact on the development of the child (Bronfenbrenner, 1979). These microsystems are characterized by activities, interpersonal relationships, and roles, which play a vital role in the two processes that are the "principal engines" of development (Garbarino, 1982, p. 35). These processes include social interaction with numerous people of varying types as well as engagement in activities and tasks that become increasingly more complex. These enduring forms of interaction within the environment are also known as proximal processes.

While the microsystems are the contexts within which the child experiences most interactions, the outer and connecting systems can be just as important in the development process. When there is connection between two or more microsystems, such as between peers and school, a mesosystem is formed. Mesosystems are made up of important environmental factors such as interpersonal relationships, roles and activities. More importantly, however, is the "synergistic effects created by the interaction of developmentally instigative or inhibitory features and processes present in each setting" (Bronfenbrenner, 1993, p. 22).



**Figure 1-2. Bronfenbrenner's ecological model.**

*Source:* ©Meece, 1997, p. 29. Reprinted with permission.

At the next level of the model are the connections between two or more settings or the exosystem (green). The exosystem is at such a level that the child does not have any direct participation in the components of the exosystem. An example of an exosystem may be the link between parent's workplace and the home or the neighborhood and peers. The exosystem, although not directly involved in the

developmental process, still plays a significant role in the development of a child. Decisions made at the exosystem level are about “the whole range of things that shape the actual context and process of a child’s microsystem” (Garbarino 1982, p. 44) and can significantly impact the child.

The outer most level of Bronfenbrenner’s model is the macrosystem (yellow). The macrosystem includes the influential factors of politics, cultural ideologies, economic factors, science and technology, and laws. These factors affect all other systems nested within the macrosystem. Changes at the macrosystem level will ultimately produce developmental changes within all other contexts (Garbarino, 1982).

In recent years, Bronfenbrenner and Morris (1998) made revisions to the ecological model. These changes focused on the developmental processes and their distinction from the environment and redefined the ecological model as the bioecological model. Within the context of this new model two propositions were posited. Proposition I states:

human development takes place through processes of progressively more complex reciprocal interaction between an active, evolving biopsychological human organism and the persons, objects, and symbols in its immediate external environment. To be effective, the interaction must occur on a fairly regular basis over extended periods of *time*. Such enduring forms of interaction in the immediate environment are referred to as *proximal processes*. (Bronfenbrenner & Morris, 1998, p. 996)

Proposition II states:

The form, power, content, and direction of the proximal processes affecting development vary systematically as a joint function of the characteristics of the developing person; of the environment-both immediate and remote-in which the processes are taking place; the nature of the developmental outcomes under consideration; and the social continuities and changes

occurring over time through the life course and the historical period during which the person has lived. (Bronfenbrenner & Morris, 1998, p. 996)

Bronfenbrenner and Morris (1998) go on to further define the proximal processes by describing several properties that make these processes distinctive. The first of these properties states that activity must take place for development to occur. The second property elaborates on the first by stating that such activity should take place on a regular basis over an extended period of time for it to be effective. Additionally, these activities should become increasingly complex and not merely repetitive. The fourth property explains how the interaction should not be unidirectional, but rather a degree of reciprocity is necessary. The fifth property of proximal processes puts forth the notion that the interaction of the proximal process does not always involve people; interactions may also involve objects and symbols. In line with the fourth property, these objects and symbols should be such that they invite attention, exploration, manipulation, elaboration, and imagination. The final property is concerned with factors specified in Proposition II. In essence, as children grow older their capacity to develop increases in level and range. If the proximal processes are to remain effective, they should become more extensive and complex as development occurs. Although the time between activities can be longer, the activities should continue to occur on a regular basis. Bronfenbrenner and Morris further this property by adding that it is not just the parents that function in the interactive role. As children grow, other persons such as caregivers, siblings, relatives, peers, teachers, mentors, spouses, coworkers, superiors, and subordinates at work, respectively, change over time and continue to interact "on a fairly regular basis over extended periods of time" with the developing person. Essentially, persons

in this role are not restricted to the formative developmental years, but change, as does the person (Bronfenbrenner & Morris, 1998, pp. 996-997).

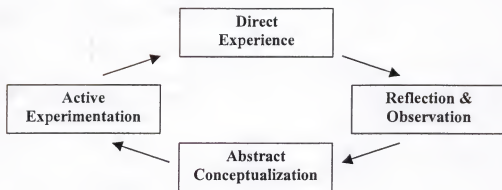
### **Experiential Learning Theory**

Learning by doing is the cornerstone of experiential learning. The idea that knowledge is gained through experience is rooted in the teachings of Aristotle (Zilbert & Leske, 1989). Aristotle's ideas of experience and learning were in contrast to Plato's theory that knowledge is gained through reasoning, not through one's senses. "While modern science has largely adopted the empirical view (Aristotle) for the definition of knowledge, the rational view (Plato) is dominant in the transmission of knowledge" (Zilbert & Leske, 1989, p.1). Although the idea of experiential learning has been around for some time, most formal schooling still educates students using rational processes, which, in most cases, makes the theories taught seemingly unrelated to the "real" world (Zilbert & Leske, 1989, p. 1).

John Dewey (1938) was one of the first educators to promote experiential learning as a viable teaching method that links education, work, and the individual. Dewey believed that students should learn, not from textbooks, but from direct learning experiences. Dewey stated that textbooks, while important, do not provide problems that are real to the student. Only when students are exposed to experiential learning techniques that maximize their skills in learning from their own experience can the full potential for learning be realized (Kolb & Lewis, 1986). Since Dewey's first theories of education and experience, many theories and definitions of experiential learning have arisen. Keeton and Tate's (1978, p. 2) definition of experiential learning compiles many of the concepts common to experiential learning

theories: "it [experiential learning] involves direct encounter with the phenomenon being studied rather than merely thinking about the encounter or only considering the possibility of doing something with it." Dewey did note, however that not all experiences are educative. "Only when experiences can be expressed as new ideas, when the lessons of experience can be drawn, articulated, and acted on, will development have taken place" (Stone, 1994, p. 6).

One of the most commonly accepted models of experiential learning is Kolb's (1984) model (Figure 1-3), which is composed of four stages: direct experiences, reflection and observation, abstract conceptualization, and active experimentation. The first stage, concrete or direct experience, requires students to have personal experience with the area/concept being studied. In this first stage, giving students the opportunity to directly experience the phenomenon being studied can make the phenomenon more meaningful and relevant (Osborne, 1994). The second stage of Kolb's experiential learning model is reflection and observation. During this stage students reflect on and make observations about the completed experience. This stage is important as students begin to transform the experience into new knowledge. Abstract conceptualization is the third stage that requires students to generalize about the experience and elements of the experience, and relate it to existing knowledge. During the final stage, active experimentation, students develop new theories based on the generalizations they reached in the third stage and begin to test these new theories (Osborne, 1994; Stone, 1994).



**Figure 1-3. Experiential learning model.**  
Based on Kolb's (1984) model.

For most people, progressing through this cycle occurs subconsciously and it is up to educators to bring this cycle of learning to the conscious level for learning to occur (Stone, 1994). Osborne (1994, p. 3) states that most educators have a subject matter orientation to teaching and hence this starts the learning cycle at stage three with educators providing students with the “whats,” “hows,” and facts first, with experiences of the subject matter, if any, coming later. Educators instead, need to start the learning process with the direct, concrete experiences in order to place the subject matter into a real-world problem context. Additionally, by starting the learning cycle with direct and concrete experiences, interest in the subject is usually stimulated, students are motivated to learn more, and a strong context for reflection and application is provided (Osborne, 1994). According to Proudman (1992, p. 20), “good experiential learning combines direct experience that is meaningful to the student with guided reflection and analysis. It is a challenging, active, student-centered process that impels students toward opportunities for taking initiative, responsibility and decision making.”

### **Theoretical Relationships**

Developing an understanding of children's cognitive development and the role education plays in that development is important when assessing the possible benefits an educational technique has on the development of children. The four theories of cognitive development discussed previously may be seemingly unrelated, but are, in fact, complimentary when assessing youth development and the many factors that contribute to such development. The relationships of the above mentioned theories are summarized below.

1. Children are central figures in their own development.

According to Piaget, children structure their own knowledge. They must act on new knowledge by manipulating and transforming it so that it makes sense (Meece, 1997). Vygotsky's theory that social interactions are necessary for development also gives children a central role as it is their interactions with adults and peers that can stimulate development. Additionally, Vygotsky's notions of social, egocentric, and inner speech are indicative of how children shape their own development. Bandura's view of triadic reciprocity of interacting elements of personal factors, behavior, and the environment does not put the child in a central role, but rather as contributing two-thirds of the elements (personal factors and behavior) to the reciprocity model. Additionally, Bandura's theory of enactive learning, learning by experiencing the consequences of one's own actions places the child in a central role. Tying these theories together is Bronfenbrenner's ecological theory. In Bronfenbrenner's model, the child is placed at the center and is embedded

in all the other systems. His theory puts the child in an environmental context and depicts how these contexts influence the child's development.

2. Social interactions are key elements for development.

One of the hallmarks of Piaget's theory is his notion of equilibration.

Equilibration occurs when balance is achieved and maintained between what is known and unknown. Social interaction with adults and peers often results in conflicting opinion. This conflict will cause children to be in disequilibrium with their current knowledge and therefore a subsequent reconciliation of the conflict will occur in order to reach equilibrium. Piaget contended that real intellectual activity can not occur without social interaction and collaboration with others. Similarly, Vygotsky's theory of sociocultural development is based on the social interactions of the child with others. The premise of his theory is that children develop cognitively when they internalize the products of their social interactions (Meece, 1997). In addition, one of Vygotsky's most important constructs, the zone of proximal development, is based on the notion that adults lead children into more complex levels of functioning and knowledge and therefore enhancing cognitive development (Gage & Berliner, 1988). This theory of interactions is also tied in with Bandura's triadic reciprocity concept. Cognitive development in this respect is the result of skills and structures gained through social interactions within the child's environment. Bandura's notion of vicarious learning is also centered on the child's social interaction with others as vicarious learning is done by observing others (Bandura, 1986; Woolfork, 1998). Bronfenbrenner's ecological model is based on the synergistic interactions among the child, others, and systems close to and beyond

his immediate realm. Included in "principal engines" of development in Bronfenbrenner's model are the social interactions with numerous people that over time become more complex (Garbarino, 1982, p.35).

3. Children's environments play a significant role in their development.

Closely tied to the social interactions children experience that contribute to their development is the environment in which they are developing. Piaget's main contention is that children will develop in stages at certain times in their lives. He does, however, point out that the age ranges that define his stages of development may be affected by cultural and environmental factors (Meece, 1997). Additionally, since children construct their own knowledge, according to Piaget, the environment in which they construct this knowledge is dependent on that environment. Vygotsky's theory of cognitive development also places the child within the context of his environment. He believed that it is impossible to understand a child's development without some understanding of the culture in which the child is reared. Cognitive development, as he viewed it, is a direct result of the cultural institutions and social activities a child is exposed to while growing up (Meece, 1997). Within Bandura's triadic reciprocity model is the environmental factor contributing to cognitive development. Bandura emphasized the importance of the interactions between a person and the environment in cognitive development. These interactions are the basis for learning by observation, symbolic construction, forethought, self-reflection and self-regulation (Ferrari, 1998; Good & Brophy, 1995). Bronfenbrenner viewed development as the constant interaction of humans with the environment. While the child is central to his development, certain environmental contexts have significant

impacts on the child's development. These environmental contexts range from immediate to far removed, but each influences a child's development through direct and indirect interactions.

4. Experience is necessary for learning and development.

The final connecting factor of each of these theories is that experience is essential to a child's cognitive development. Piaget believed that children can not develop by reading or hearing about principles. "Children need opportunities to explore, to experiment, to search for answers to their own questions." Additionally, "knowledge gained from physical experiences must be acted on, transformed, and compared with existing knowledge structures" (Meece, 1997, p. 146). The age group in question for this study, 9 to 10 year olds, would be in the concrete operational stage, according to Piaget. This stage is characterized by a child's ability to solve problems logically through hand-on, active experimentation. Teaching applications of Piaget's theory call for classrooms that allow for learning through active experimentation, self-directed learning through problem solving and experimentation, and concrete learning experiences that are relevant to their lives (Meece, 1997). While experience is not one of Vygotsky's theoretical premises, his zone of proximal development notion can be tied to experiences. In theory, if a child is introduced to a new experience she/he can learn from it through interactions with more knowledgeable adults who help him to understand the experience. Experience is also important to Bandura's social cognitive theory when seen in the context of enactive learning. Enactive learning takes place when a child learns from his own experiences (Bandura, 1986). Without experiences, an important type of learning, as defined by

Bandura, is neglected. Bronfenbrenner's proximal processes of development are distinguished by several properties that call for experience. Activity must take place, and it must then take place on a regular basis over time. This activity must become increasingly more complex and there must be some degree of reciprocity. Finally, the activity must invite attention, exploration, manipulation, elaboration, and imagination to be a source of development.

### **Summary Statement of the Problem**

School gardens have anecdotally been seen to promote the positive developmental assets of achievement motivation, school engagement, responsibility, and interpersonal competence (Anon., 1992; Becker, 1995; Berghorn, 1988; Braun, 1994; Canaris, 1995; Craig, 1997; Davies, 1995; Dwight, 1992; Gwynn, 1988; Neer, 1990; Pivnick, 1994). Additionally, educators and researchers have both cited the experience of a school garden as enhancing environmental attitudes (Alexander et al., 1995; Barker, 1992; Becker, 1995; Canaris, 1995; Chawla, 1994; Gwynn, 1988; Heffernan, 1994; Pennington, 1988; Pivnick, 1994; Skelly, 1997; Stetson, 1991; Waliczek, 1997; Wotowiec, 1975). While Harvey (1990) found that students using school gardens or vegetative school grounds had higher scores of botanical knowledge than students not using gardens or grounds, no research has addressed the possibility of school gardens affecting students' attitudes toward science. Many teachers use school gardens to enhance science lessons and so it is theorized that a school garden may have an effect on students' attitudes toward science.

The theories of Piaget and Vygotsky provide a framework for understanding how a school garden may have an impact on the cognitive development of students who participate in garden projects. The population under investigation in this study is third grade students who range in age from 9 to 11 years. Within the context of Piaget's model, these students are within the concrete operational stage. This means they are at a level where they are thinking logically through attainments of reversible thinking, conservation, classification, seriation, negation, identity, and compensation. Additionally, children are able to solve concrete or hands-on problems logically. The school garden is a place where hands-on problem solving is a necessity. A survey of Florida elementary teachers found that a majority (73 %) of teachers surveyed used the garden for experiential learning (Skelly & Bradley, 2000). While the garden may be a tool for experiential learning, students in this age group are not able to think abstractly and therefore do not reach the abstract conceptualization stage of the experiential learning cycle. However, through social interaction with their teacher and peers, children may be brought to the zone of proximal development, which may prepare them to start thinking abstractly.

While the garden is a place and a tool for learning, it is also a place for social interaction with teachers, adults and fellow students. These interactions may, according to Vygotsky's theory, be a form of intellectual scaffolding within a child's zone of proximal development. The garden is a tool that, depending on how it is used, can provide a teacher with the means to teach new information in a manner that is fun for students, but that also engages students in a way that is exciting to them through hands-on problem solving. Although the practices addressed in Table 1-2 are

guidelines for teaching math to 4- and 5- year olds, some of the guidelines can be addressed through garden education. The garden can provide an active learning environment where students can explore and interact with peers and adults.

Additionally, a garden can provide the setting for concrete learning activities that are relevant to their lives. Education in a garden can also give students opportunities to experiment, draw conclusions, and solve problems. While some of the processes of growing a garden may be somewhat abstract or above the intellectual level of a third grader, by observing these processes the student may be challenged. This challenge can be remedied through interaction with their teacher, parents, and other students. With the teacher or other influential persons helping the child to understand these complex processes, the child must accommodate or assimilate the new information, while at the same time they are being brought into the zone of proximal development that will help them to eventually understand such processes.

Bronfenbrenner's ecological theory is helpful when assessing the context of how a school garden may influence the development of positive assets. The interactions within environmental settings can be influential enough to enhance or discourage development. In light of these theoretical foundations, Bronfenbrenner's ecological/bioecological model can be guides for actions and interactions (Ferarri 1998).

These models provide a framework for understanding how interactions between individual's and their environment can enhance or discourage development. At most elementary schools, students primarily stay in one classroom for the duration of a school day, therefore the microsystem or context under investigation is the

classroom and what effects this context has on the individual students in this classroom. The school garden is an educational method that is an extension of the classroom, which provides the setting for the activities that drive the engines of development. Depending on how the garden is used by both teacher and student it may play a role in the developmental processes that take place in this contextual setting. In this classroom system, there are several factors that may affect a child's development; the interaction with the teacher, interaction among students in the same class, and interactions within the garden both with animate and inanimate objects. These interactions may have a significant impact on the development of the children within this classroom.

## CHAPTER 2 REVIEW OF LITERATURE

### Benefits of Gardening

Gardening has been a way of life for thousands of years. The first gardens to be cultivated were done so out of utilitarian need. Gardens for beauty were, in ancient times, a luxury that was not often afforded (Hobhouse, 1997). The practice of gardening, or horticulture, started with the domestication of wild grains. This new cultivation of plants was to change the nomadic hunter/gatherer into the agriculturist (Wright, 1934). In the millennia that have passed since the dawn of the first agriculturists, gardening has become a way of life in today's society. While people still garden for the purposes of growing food, many people now garden for aesthetic purposes as well as for their own pleasure (Hobhouse, 1997). Charles Lewis, one of the first people to document the positive effects of gardening and green spaces, believes that gardening and plants can have a profound impact on people. He states,

Gardening is a process. Its products – plants, flowers, lawns, shrubs – are easily seen, but what do we know of the process that produces them? The process of gardening includes all the thoughts, actions, and responses from the time the gardening activity is first contemplated, through the planting and growth of the seed, to the mature plant. Personal feelings and benefits can be seen as by-products, effects unintentionally produced by the process. (Lewis, 1996, pp. 56-57)

It is these by-products of gardening, the personal feelings and benefits, that make gardening such a popular pastime.

According to a 1988 study conducted by the National Gardening Association, 70 million households engage in some form of gardening (Robbins, 1988). In a more recent study, the National Gardening Association (1997) reports that 67 % of Americans participate in garden activities. These numbers indicate that gardening is practiced by many and that with so many people gardening, there must be benefits derived from this practice. To assess some of these benefits, the National Gardening Association surveyed approximately 2000 gardeners in 50 states. Ninety-six percent of those surveyed agreed with the following statements:

one of the most satisfying aspects of gardening is the peace and tranquility it brings; gardening gives me a sense of control over my environment; being around plants makes me feel calmer and more relaxed; the natural world is essential to my well being. (Butterfield & Relf, 1992, p. 212)

Obviously, gardening is a passion that many people enjoy and from which many people derive benefits.

Research exploring the benefits of gardening has revealed that gardens provide many benefits to gardeners (Kaplan, 1973; Patel, 1996; Waliczek, Zajicek, & Matteson, 1996). In an article entitled "Some Psychological Benefits of Gardening," Rachel Kaplan (1973) discusses the reasons for and benefits received from gardening. She begins by discussing several advantages in exploring gardening as an activity that produces benefits associated with nature experiences. The first advantage she points out is that "nature is clearly an essential component and not a background which might be ignored by participants" (p. 145). She adds that nature "requires a continuing contact and thus represents a commitment rather than a chance or causal experience with the outdoor environment" (p. 146). Finally, Kaplan contends that gardening "is a close-at-hand form of leisure activity. This tends both to decrease its

'image' value and to increase its potential role in an individual's psychological economy by its very accessibility and frequency of contact" (p. 146).

Kaplan recognizes that gardening is an activity that is enjoyed by many and is appealing for a large number of reasons. From this observation she asks "is there a core, an essence to the gardening experience that touches all who participate?" (p. 146). Kaplan suggests that there are two distinct benefits derived from the gardening experience. The first benefit is that gardening provides a source of fascination and the second is that gardening gives people a chance to have control over the production of their own food and thus are able to participate in their basic survival.

In order to explore whether anecdotal evidence of these perceived benefits actually existed, Kaplan (1973) carried out a study to explore the patterns of psychological benefits associated with the garden experience and whether there existed variables (demographic and attitudinal) that predicted these benefits. She surveyed a sample of community, home, and plot gardeners for this study. Analyses of the survey data found three categories of psychological benefits. The first benefit category pertained to variables that make up tangible benefits. Tangible benefits included the enjoyment of producing one's own food, reducing food expenses, and harvesting from the garden. The second category of benefits identified by the researcher were the primary garden experiences people received from gardening. Primary garden experiences included a desire to work in the soil, wanting to see things grow, enjoyment of being outside, and interest in learning about gardening. The third category of benefits revealed in the study were those that related to sustained interest. Benefits measured by the Sustained Interest Scale (Kaplan, 1973)

were the “ability to sustain interest, valuable way to spend time, diversion from routine, aesthetic pleasure from plants, opportunity to relax, and provide a sense of accomplishment” (p. 153).

Kaplan reasoned that the high mean associated with the sustained interest scale reflected the idea that gardening is indeed a powerful source of fascination.

Kaplan reasoned that a garden holds this sense of fascination because

it calls on the basic informational processes that humans do so well and presumably care so deeply about. It not only permits, but actually invites recognition, prediction, control, and evaluation. [Gardening] does this by providing knowledge and requiring it. It is a setting that allows for order, but that order is deeply embedded in uncertainty and change. Thus, it challenges the human information-processing capability, and to the extent that the challenge is met, both reward and more challenge are forthcoming. (Kaplan, 1973, p. 160)

Kaplan also reasoned that gardening holds a sense of fascination because it is a nature-based activity and this had been previously shown by Kaplan and Wendt (1972) to be an activity of preference. Additionally, Kaplan contended that fascination is natural in a garden because a garden is also a place where nature is condensed and intensified in a miniature setting. Within this setting, natural processes, actions, and cycles can be played out and observed. Viewing such phenomena can only lead to fascination.

In a similar study, Patel (1996) surveyed the participants of a community education program designed to teach community leadership, provide gardening and clinic workshops, and to host several garden recognition programs to identify the benefits of gardening. Patel’s survey of participants found that the people who partook in the garden education program reaped many benefits through gardening. He reported that over one quarter of his sample of 300 community gardeners helped

others and shared their produce. Additionally, 44% of participants benefited from receiving fresh vegetables; 35% reported an improvement in their diet; and 33% were able to save money by gardening. The community gardeners in Patel's program also reported that they developed friendships (31%) and felt that an improvement in their neighborhood was made (13%).

In an attempt to determine if gardening improved the quality of life of community gardeners, Waliczek, Zajicek, and Mattson (1996) surveyed 361 gardeners from 36 community gardens. These researchers found significant differences among ethnic groups' reasons for gardening. "Working outside, working with nature, and feeling healthier from eating produce" (p. 34) were rated as more important by African-American and Hispanic gardeners as compared to Caucasian and Asian gardeners. All ethnic groups reported that they felt it was important to have a community garden to help promote community involvement. When exploring the concept of self-esteem with community gardeners, researchers found that statements assessing self-esteem and self-actualization were rated higher (more important) among African-American and Hispanic gardeners than Caucasian and Asian gardeners. Overall, the researchers of this study concluded that the community gardens and participation in the gardens provided many quality-of-life benefits to the gardeners.

While research exploring the benefits of gardening has focused mainly on community gardeners and homeowners, research examining the benefits of gardening on children has remained relatively unexamined. It may be logical to assume that children may experience benefits similar to adults, however this assumption may be

inaccurate and proper research is necessary to determine the benefits children derive from gardening. Therefore, the purpose of this study was to determine what benefits, if any, children using school gardens were experiencing.

### History of School Gardens

The use of school gardens in American can be traced back to the late 1800s. However, long before school gardens made their way into American school systems, European schools had embraced school gardens. Some historians even trace the beginnings of school gardens as far back as 1015 BC when King Solomon had extensive gardens that were thought to be used for the purposes of instruction (Bachert, 1976). While this link may be weak, Bachert (1976) cites many references that date school gardens back to 1525 AD. He presents an examination of significant dates that marks the spread of school gardens. The earliest known school gardens were linked to the botanical gardens of Italy and other universities in 1525 AD. Several publications promoted the idea of schools gardens: Amos Comenius' *Didactica* maintaining that a garden should be connected with each school (1592-1672) and J. J. Rousseau's *Emile* (publication) noting the importance of garden work as an educational factor (1762). In 1840, Fredrick Froebel founded the first kindergarten, a place where light gardening was thought to enhance play and education. After Froebel's kindergarten idea, school gardens went on to be established in the larger German cities. On March 14, 1869, Austrian imperial school law prescribed that a garden or agricultural place be established at every rural school (Bachert 1976, p.18).

With the widespread occurrence of school gardens throughout Europe, America was beginning to take notice. Bachert argues that the transition of school gardens into America most likely occurred through:

visits by Americans to Europe, visits by European educators to America, influence of immigrants who had been exposed to school gardens in their own education in Europe, translations and reprinting of books in America, and articles printed in American magazines and journals about school gardens in Europe. (Bachert, 1976, p. 20)

Henry Lincoln Clapp, who according to Bachert, is known as the "Father of school gardening in America," provided the initial steps in bringing and starting school gardens in America. Clapp was sent by the Massachusetts Horticultural Society (MHS) to study the school gardens in Europe. Clapp's report on the school gardens in Europe encouraged schools in America to follow suit and prompted the MHS to begin working with schools to install window box gardens. The MHS's promotion of window box gardens is argued to be the first development of school gardens in America (Bachert, 1976).

Henry Lincoln Clapp's report stated that there were 81,000 school gardens in Europe in 1890. Upon revealing this to a meeting of the Massachusetts Horticultural Society in 1891, the school garden movement in America blossomed. Although the MHS had started window box gardens at several schools, the first school garden in America is thought to have been a garden that Clapp started at the Henry Putnam School in Roxbury, Massachusetts. The garden at the Henry Putnam School was a vegetable garden that allowed for the scientific study of plants. After this first school garden was established, the movement in America was still slow going. Prior to 1900 only about four to five school gardens existed. However, by 1906 the movement had

caught on, and according to an estimate by the United States Department of Agriculture, there were approximately 75,000 school gardens being maintained in 1906. By 1910 this number had risen to about 80,000 schools (Bachert, 1976).

Once the school garden movement had taken off, several organizations formed to promote and encourage school gardens and to help teachers gain access to school garden information and literature. Several of the organizations formed were the School Garden Association of New York instituted by the American Museum of Natural History and the International Children's School Farm League. In addition, the Massachusetts Horticultural Society continued to play a significant role in promoting school gardens by organizing the first Children's Garden Conference. Other established organizations such as the Village Improvement Society of Groton, Massachusetts, the Women's Institute of Yonkers, New York, the American Civic Association, the American Park and Outdoor Art Association, the Civic League, and the Twentieth Century Club also became involved in the school garden movement (Bachert, 1976).

With the support of many organizations, school gardens began to grow throughout America. In Illinois, the Farmer Boy's Experiment Club was started to provide country boys with more practical training and education about the country they lived in. The club's activities included reading of agricultural literature produced by the Agriculture College of Extension, field trips to the Agricultural College and Experiment Station, and experiments with seeds and plants on the students' own field plots. The club was such a success that a Girl's Home Culture Club was formed.

Another successful garden organization was the National Cash Register Boy's Garden in Ohio. This garden was started by the president of the National Cash Register Company in an effort to stimulate thought and activity in the young boys of his employees. While this garden was not a true school garden, it was established with many of the same instructional and developmental elements as school gardens and served as a model for many school gardens. J. H. Patterson, the president of the company, felt that his upbringing on a farm was one of the reasons he was successful and wanted to share similar experiences with the boys of employees that worked for him. Patterson believed that a garden would be "a place to foster the physical, mental, and moral development of the boys of his employees and of the neighborhood surrounding the factory" (Basset, 1979, p. 18).

In Bachert's (1976) analysis of the school garden movement in America from 1890-1910, he discusses how school gardens were used in conjunction the with school curriculum. Henry Lincoln Clapp was the first to recognize the link of the school garden with the curriculum being taught. He wrote: "To ignore the garden as an educational means in elementary schools is as unwise as it is to leave it out of the kindergartens." Clapp went on to add that "the absence of the school garden is the most radical defect in our elementary education" (Clapp, 1901, p. 611 as cited by Bachert, 1976, p. 86). *The Report of the Commissioner of Education for the Year 1898-99* stated that "gardens are a necessary part of school and attain their educational value by being connected with them" (Gang, 1900, p. 1080 as cited by Bachert, 1976, p. 87). The American Park and Outdoor Art Association strongly defended school gardens and the values that came from them. The association felt

that gardens were the answer to a better education for children and as a means to solve many of the problems that existed in society (Bachert, 1976). School gardens were also thought of as tools to teach many classroom subjects. In a book entitled *How to Make School Gardens: A Manual for Teachers and Pupils*, by Hemenway (1903 as cited by Bachert, 1976) wrote that school gardens could be used to teach practically every subject taught in the classroom. Lessons on plant life, science lessons, arithmetic, geography, art, nature study, reading, language, composition, spelling, and physical education were all cited as subject areas that could be addressed using and teaching with school gardens (Bachert, 1976).

The spread of school gardens throughout America was most predominant in the major cities in the early 1900's, with the movement spreading as far as Honolulu, Hawaii. DeMarco (1999) states that the use of school gardens has fluctuated since the early 1900's due to the social and educational climate of the times. As teaching and learning styles change, so does the acceptance or rejection of school gardens as teaching tools. There has been little documentation of the school garden movement since 1910, however the plethora of anecdotal articles written by educators on school gardens is a testament that the movement is still alive today.

### **Benefits of School Gardens**

In addition to the benefits cited by proponents of early school gardens, other educators and researchers have recognized the benefits of school gardens to children. Upon conclusion of his survey of the school garden movement from 1890 to 1910, Bachert (1976) concluded that youth garden programs provided several benefits to students. These benefits included physical improvement, sharpening of mental

faculties, social gains, value for special populations, economic value, and moral growth.

Maria Montessori (1912) was one of the first educators to document the benefits gardening could have on school children. Montessori recognized several benefits of gardening with children. The first benefit she noticed was that children began to care for living things and life. In having to care for living things – plants – so that they would stay alive, Montessori found that children were learning responsibility. Another benefit recognized by Montessori was that children were learning how to accomplish tasks independent of their teacher, and therefore they were becoming more self-reliant. Waiting for plants to grow requires patience, another virtue Montessori witnessed developing in her students. Montessori believed allowing children to work outside in the garden gave them opportunities to intelligently contemplate nature. Finally, Montessori noted that working in the garden helped her students to work together and gain interpersonal skills.

Other educators have also testified to the benefits of school gardens. Based on a review of literature, four categories of school garden benefits were identified. The following is a categorization of the perceived benefits of school gardens discussed in anecdotal articles: 1) moral development, 2) academic learning, 3) sense of community, and 4) environmental awareness.

### **Moral Development**

School gardens are a place to develop social skills such as sharing, teamwork, and cooperation (Becker, 1995; Berghorn, 1988; Canaris, 1995; Gwynn, 1988; In Virginia, 1992; Neer, 1990). Another virtue observed in children who use school

gardens is patience (Craig, 1997; Pivnick, 1994). Other developmental benefits witnessed by educators are self-control, pride in a product and their garden (Becker, 1995; Braun, 1989; Craig, 1997; Dwight, 1992; Neer, 1990), increased self-esteem (Craig, 1997), self-confidence (Chawla, 1994; Dwight, 1992), and a sense of self-reliance and accomplishment (Henry & DeLauro, 1996). Teachers also recognized that their students were developing the skills of leadership, organization, planning (Berghorn, 1988), responsibility (Canaris, 1995; Gwynn, 1988), and discipline for being on time, following directions, and making decisions (Dwight, 1992). Several teachers observed their students developing a work ethic: a widened understanding of work – that work can be personally meaningful (Canaris, 1995), that work is useful and appreciated (Braun, 1989; Dwight, 1992), and a respect of work (Becker, 1995). Finally, positive feelings toward school and a desire to participate in school activities was noticed in students who were part of a school garden program (Lucas, 1995; Stetson, 1991).

### **Academic Learning**

One of the first benefits teachers point out about school gardens is how they make learning fun (Stetson, 1991), exciting (Gwynn, 1988), and promote an enthusiastic response from students (Canaris, 1995). Educators also point out that school gardens aid in problem solving, observation, and predicting skills (Nelson, 1988; Stetson, 1991). School gardens also help students gain better understandings of social studies, math, science (Stetson, 1991), the process of getting food from the field to the table (Braun, 1989; Canaris, 1995), life cycles, habitats, weather, plants (Gwynn, 1988; Oehring, 1993), nutrition (Canaris, 1995), and abstract concepts

(Kutsunai, 1994). Braun (1989) contends that the garden helps students to apply what they learn in one subject to concepts they have learned in other subjects. The educational benefits of school gardens are reported to be the result of hands-on learning and experiences (Barron, 1993; Craig, 1997 In Virginia, 1992) as well as the real world and direct experiences (Kutsunai, 1994). Teachers also report that the teaching and learning in the garden leads to higher science scores (Stetson, 1991) and improved academic achievement (Braun, 1989).

### **Sense of Community**

According to many teachers, the garden is an entity that promotes a sense of community both in terms of students contributing to and feeling a part of the community. Sharing the garden with others (Neer, 1990) and donating grown produce to food banks (Canaris, 1995) are two cited examples of how students feel they contribute to the community. Bringing in senior citizens to help with the garden also fosters a sense of community connectedness (Barron, 1993; Canaris, 1995). Allowing students and seniors to work together is seen to cultivate a connection between the young and old (Braun, 1989; Dwight, 1992). A sense of community is also developed through parental involvement (Kutsunai, 1994) and interaction and commonality with other students (Dwight, 1992; In Virginia, 1992).

### **Environmental Awareness**

According to Pennington (1988, p. 1), "gardening is a transforming activity that moves us from ignorance to understanding and appreciation, from passivity to action, from a state of dependence to one of independence with nature and others in

our community.” Many educators recognize the potential of a school garden to accomplish this claim. Several teachers credit the school garden as helping students to recognize the importance of nature and to gain an appreciation of nature (Gwynn, 1988). Gardens are reported to help students connect and bond to nature (Chawla, 1994; Pivnick, 1994), as well as help students discover the wonders of nature (Becker, 1995). These connections to nature are important and necessary if children are to develop an environmental ethic (Pivnick, 1994). Teachers point out that school gardens help students develop respect for living things (Stetson, 1991), gain environmental sensitivity and empathy (Chawla, 1994), as well as teach children to nurture and care for living things (Canaris, 1995). Heffernan (1994, p. 223) states that “gardens are the most accessible places for children to learn about nature’s beauty, interconnections, power, fragility, and solace” and that “gardening shows children they can bring beauty into the world with their own actions.”

These anecdotal citations provide insight into how school gardens may affect the students that use them. While these benefits are observations of individual teachers, there is merit to their recognition that school gardens benefit their students. These observations help researchers shape their research questions and develop a strategy for carrying out empirical studies of school garden benefits.

### **School Garden Research**

Research in the area of school gardens is limited even though school gardens have been in existence for hundreds of years. As is evident from the anecdotal descriptions of school garden benefits, there is agreement among teachers using school gardens that they are beneficial to the students. For the purposes of this study,

teachers and students were the subjects of research. Therefore, this section will outline the existing research conducted with both teachers and students using school gardens.

### **Research with Teachers Using School Gardens**

DeMarco (1999) carried out a study to determine the factors that aid in the development and successful implementation of elementary school gardens. Her study included a survey of 236 teachers who used school gardens and personal interviews with 28 teachers who were experienced using school gardens. All teachers surveyed or interviewed were selected from a sample of schools that had received a Youth Garden Grant from the National Gardening Association in 1994/1995 and 1995/1996.

Analyses of the survey and interview data showed that there are several factors important to the success of school gardening programs. A sense of ownership of the garden by teachers and students was one of the most important factors identified. DeMarco explained that for the school garden to be used and accepted by teachers and students, all involved in the garden must feel ownership in order for them to take responsibility for the garden. Additionally, students must feel ownership of the learning that occurs in the garden and such learning should be spread throughout the curriculum.

The final part of DeMarco's (1999) study was to assess how teachers' perceptions of the effectiveness of school gardens as a teaching tool. Almost all of the teachers in the study (96%) felt that school gardening was an effective teaching strategy that enhanced the learning of their students. This same percentage of teachers also felt that the school garden helped students learn and understand new

ideas and concepts. Additionally, all of the teachers surveyed and interviewed indicated that students' environmental attitudes became more positive after using the school garden.

In a similar study, Skelly and Bradley (2000) conducted a survey of Florida elementary school teachers using school gardens to find out their perceptions of the importance of school gardens. Seventy-one teachers from 35 schools participated in the survey. The most popular types of gardens used by the teachers were flower (84%) and vegetable gardens (71%), with butterfly (41%) and herb (39%) gardens following. In most cases, teachers were using a combination of all types of gardens. Follow-up interviews with several teachers revealed that vegetable and butterfly gardens were used primarily for science lessons, while flower gardens were used to beautify school grounds.

When asked why they used school gardens, all but two of the teachers (97%) remarked that the garden was used for environmental education, and a majority of the teachers (73%) noted that they used the garden for experiential learning. Eighty-four percent of the teachers felt that the garden helped their students learn better.

Findings from these two studies showed that teachers are using school gardens and believe that school gardens enhanced the learning of their students. It is apparent that teachers in these studies understood the usefulness and the potential benefits of school gardens in the classroom and to their students.

### **Research with Students using School Gardens**

Research focusing on students who use school gardens and subsequent benefits is limited. To date, only eight known documented research studies have

focused on the benefits students receive by participating in school garden programs. This section will review these eight research studies and how they relate to the current study. The research studies have been divided into those conducted through interview research and those conducted using survey research.

### **Interview research**

Barker (1992) carried out a naturalistic inquiry study of the Hilltop Garden/Nature Center in Bloomington, Indiana to find out the meaning of the garden to participants. Barker conducted observations at the Center and interviewed 10 participants to gain an understanding of how participants viewed the educational, leisure, and social aspects of the program. The researcher observed participants for 25 of the 33 days the Center was open. She then conducted interviews with 9 participants – 4 garden participants and 5 junior board members. Junior board members were different from garden participants in that members were selected by Center staff to be a board member based on students' previous experience with youth gardening, their ability to learn and apply skills, and their leadership potential. The junior board members interviewed were all older (ages 11 to 16) than the garden participants (ages 7 to 9) who were interviewed.

After analyses of her observations and interviews, Barker noted several benefits of the garden program to participants. The first benefit Barker discussed was that participants really liked and enjoyed the youth gardening program. She described the participants as "happy, active, and involved" (p. 164). Second, she found from her interviews that the participants found the program fun. Further explanation of this finding led Barker to conclude that the garden participants found

the program to be fun because it allowed them to do things and have interesting experiences. Second to this reason, the garden participants thought the social aspects of the garden to be important. These reasons were reversed for the junior board members.

Another finding Barker (1992) made was that the participants learned about nature and gardening. They learned specific knowledge and skills such as, how to garden, how to use and care for tools, how to create and follow a garden plan, how to harvest, and how to identify garden pests and weeds. Students also learned nutritional information about the vegetables they grew, and older students learned to identify the plants and flowers they were growing. Barker also found that the garden program gave participants a sense of pride. They gained this pride by showing off their garden plots, prize-winning vegetables, and garden craft projects. Participants in the program also reported that the garden gave them a sense of ownership and belonging. In relation to this finding, Barker observed that the youth garden program made the participants feel valued. Cooperation was another benefit Barker observed in the garden. Students worked together and shared their produce. For the older junior board members, Barker's observations and interviews also revealed that development of leadership skills was taking place. The one aspect all youth gardeners disliked about the gardening program was weeding.

Alexander et al. (1995) carried out a similar qualitative study to explore the benefits of classroom gardens to students. The researchers interviewed 52 students in the second and third grades, 5 teachers, 3 parents, and 1 principal from an elementary school in Texas. From these interviews the researchers found that six themes

emerged from the interview data: “moral development, academic learning, parent/child/community interaction, pleasant experiences, the influence of the Master Gardener, and perceived problems” (p. 258).

Interview data indicated that the garden gave students many opportunities to learn about life. These life lessons were described to be “delayed gratification, independence, cooperation, self-esteem, enthusiasm/anticipation, nurturing living things, motivation, pride in their activities, and exposure to role models from different walks of life” (p. 259). The academic learning theme centered on findings that school gardens allowed classroom lessons to be put into context that students could understand. Additionally, interviews showed that the garden was a place where hands-on learning, specifically about nature, could be experienced.

One of the other themes present from this study was parent/child/community interaction. Teacher interviews revealed that parents enthusiastically supported school gardens and were encouraged by their children to start gardens at home. Teachers also stated that parents became more involved in school matters and the experiences of their children at school. Teachers also commented that they believed the garden gave their students a sense of being a part of their community, as the students and their families had to care for the gardens on weekends.

Alexander et al. also found that school gardens provided a place students and teachers could have pleasant experiences. Many of these pleasant experiences came from tangible outcomes: starting with soil and seeds and harvesting edible vegetables, being independent of mom and dad for food, having fun in the garden, getting hands dirty, and watching things grow.

Another theme present from the interviews was the role and influence of the Master Gardener. Master Gardeners are individuals who have engaged in continuing education courses to learn more about horticulture and gardening experience. Master Gardeners are required to pass an exam and put in volunteer hours before the title of Master Gardener is conferred on an individual. Interviewed teachers found the Master Gardeners to be extremely helpful when gardening with students. The Master Gardeners helped create a better ratio of adults to students, provided knowledge of gardening to teachers who were novice gardeners, and helped provide a sense of community for the teachers and students (Alexander et al., 1995).

When asked about problems with the garden program, the researchers received mostly positive comments. Some of the problems mentioned by teachers and students were that they did not have enough time to garden with students, that not all of the students in the school were able to participate, and that destruction of the garden occurred due to maintenance personnel or vandalism. Overall the researchers concluded that the classroom garden program was beneficial to all involved and that many positive benefits were derived from the experience.

### **Survey research**

In a study examining the track gardening program of Cleveland Public Schools, Wotowiec (1975) found that the gardening program accomplished many of the objectives set forth by the program. Analyses of a survey administered to 404 students (3<sup>rd</sup> through 6<sup>th</sup> graders and junior and senior high school students) and their parents indicated that the objectives of developing character, promoting physical health, teaching conservation, providing practical skills, developing work habits,

providing for career exploration, and providing fresh vegetables were met. Additional analyses of the survey results, however, showed that students and parents did not believe the garden program promoted practical application of academic skills and knowledge.

School garden studies are not confined to the United States. In a study of school farms in Japan, Konoshima (1995) reported that participation in agricultural activities produced a wide variety of educational benefits, especially in primary school students. To identify the benefits to students, Konoshima distributed questionnaires to students. Examination of the survey data showed that working on the school farms helped students recognize the importance of nature. Additionally, students developed a better understanding of work and their self-control was enhanced. Of the students surveyed, 80% of the junior high students reported they had fun in the garden. Fifty percent of third graders and 70% of first graders wished to have the same farming experience in their next grade level. Questionnaires distributed to parents indicated that most parents (91%) supported the school farm projects, as these projects stimulated in their children a willingness to work on their family farms and sparked interest in farming that before participating in the projects had been dormant.

Sheffield (1992) conducted a study to find out the cognitive and affective benefits of an interdisciplinary garden-based curriculum on underachieving fourth and fifth-grade students. The underachieving students for both the control and experimental group were students who were behind one or more grade levels in reading and math, were identified by their teachers as having difficulties in school,

and had been held back at least once. The control group consisted of 12 students while the experimental group consisted of 9 students. The experimental group for this study received instruction daily for four hours via an interdisciplinary garden curriculum developed by the National Gardening Association. Garden lessons were incorporated into reading, writing, arithmetic, history, social studies, art, music, health, physical education, and creative thinking exercises.

Sheffield's analyses showed that the experimental group performed significantly better in the areas of reading comprehension, total reading, spelling, and written language. There were no significant differences found between the control and experimental group in the areas of mathematics, reading recognition, and general information.

No significant differences in self-esteem between the control and experimental group were found. However, when the individual areas were combined and weighted to give a total score, analysis showed that the experimental group scored significantly higher than the control group. This finding led the researcher to conclude that the interdisciplinary garden-based curriculum had a positive impact on students' self-esteem.

No significant difference among the control and experimental groups' attitudes toward school were found. Sheffield added that while the difference in attitude scores was not significant, the experimental group did score higher and there was evidence, witnessed by teachers, which may have indicated a more positive attitude toward school.

In a similar study, Waliczek (1997) looked at how school gardens affected students' self-esteem, interpersonal relationships, attitude toward school, and environmental attitudes. To conduct this study, Waliczek enlisted the participation of eight schools and 550 students from Texas and Kansas. Schools participating in the study received garden materials and used Project GREEN (Waliczek & Zajicek, 1996) – a garden-based curriculum incorporating math and science lessons into garden activities.

Waliczek's findings showed that there were no significant differences among the control and experimental groups on psychological measures. Students in the control and experimental groups had similar attitudes toward school, interpersonal relationships, and self-esteem. Analyses also showed that there was no difference between the pretest and posttest scores for students 8 to 11 years old. There were, however, significant differences in pre- and posttest scores of adolescent (12- to 18-year-old) students. In this case, adolescents' posttest scores were significantly more negative than pretest scores. This finding was attributed to students not wanting to get dirty and students not being academically challenged by the garden activities. Waliczek examined the data to see if there were any differences related to the demographic variables of gender, ethnicity, age group and grade levels, school, place of residence, and previous garden experience. Of these variables only gender and age group showed significant differences. Females were found to have more positive attitudes toward schools than males.

When investigating the effect of school gardens and Project GREEN on students' environmental attitudes, Waliczek found no significant differences between

pre- and posttest scores. Additionally, analyses were run to determine if there were any differences in environmental attitude scores based on age, ethnicity, and gender. Of these variables, ethnicity and gender showed statistically significant differences. Females scored higher on the posttest than males and while all ethnic groups had positive environmental attitudes, Caucasian students had significantly higher scores than African-American and Hispanic students.

In another study using the Project GREEN (Skelly & Zajicek, 1997) format, Skelly (1997) examined the effects of an interdisciplinary garden-based curriculum on the environmental attitudes of participating students. Four elementary schools in Texas agreed to participate in the study. This study followed a control/experimental group design with second and fourth grade students. The experimental group consisted of 102 second grade students and 52 fourth grade students. The control group was composed of 33 second grade students and 51 fourth grade students.

Analysis of data showed that students in the experimental group had significantly more positive environmental attitudes than students in the control group. Further analysis of the data indicated that when examining individual schools, the experimental group at each school scored significantly higher than the control group. This finding indicated that students participating in the garden program had more positive environmental attitudes than students who did not use the garden program. Results also showed that second grade students (8- to 9-year-olds) had more positive environmental attitudes than fourth grade students (10- to 11-year-olds). No significant differences were found between environmental attitude scores and the demographic variables of gender, ethnicity, and place of residence. Further analysis

showed that the number of outdoor-related experiences a student had positively correlated to their environmental attitude score.

One of the most recent studies of children and school gardens was made by Lineberger and Zajicek (2000) to assess if using a school garden and nutritional-garden based curriculum affected students' attitudes and behaviors regarding fruits and vegetables. The researchers enrolled five elementary schools in Texas to participate in the study. The sample was composed of 111 third- and fifth-grade students. A pretest/posttest experimental design was used.

Findings showed that students' attitudes toward vegetables became significantly more positive after gardening. In contrast, no differences were found in students' attitudes toward fruit. Analysis of students' attitudes toward fruit and vegetable snacks found that after gardening, students' attitudes toward snacks were more positive. Further analysis showed that female and younger students (third grade) had the greatest improvement in snack attitude scores. Although students' attitudes toward vegetables improved, students' fruit and vegetable consumption did not improve significantly.

In summary, many of the anecdotal benefits cited by educators have been legitimized through qualitative and quantitative research studies. Inspection of these anecdotes made by educators and findings of the research studies indicates that school gardens can be beneficial to students who participate in them. While research has explored the variables of self-esteem, interpersonal relationships, and attitudes toward schools none have explored how school gardens may impact the positive development of children. Additionally, very few of these studies have explored the

benefits of school gardens to students within a theoretical framework based on developmental and educational theories. The focus of this research was to design a study of school gardens that would allow for the context of a school garden to be placed within current theories of child development and to determine how such a context might ultimately affect the child. To determine the effects a school garden might have on students' development, several dependent variables were identified. These variables included youth developmental assets, student attitudes toward science, and student attitudes toward the environment. Literature addressing these variables is discussed in the following sections.

### **Youth Developmental Assets**

The Search Institute, an independent, nonprofit organization committed to advancing the well being of children and adolescents, developed the model of developmental assets through extensive research and consultations with education, child development, and community experts. The Institute's framework of assets is the product of research involving more than 500,000 6<sup>th</sup> – 12<sup>th</sup> grade students in over 600 communities throughout the country (Scales & Leffert, 1997). In the past, policies and programs for youth have primarily focused on preventive measures. Studies, however, are finding that these preventive policies and programs are not working. In response to these studies, the Search Institute developed the asset framework to help adults identify the assets that can promote positive youth development.

The asset framework is composed of 40 developmental assets which pertain to all aspects of a young person's life, including family, school, and community

influences. Search Institute views these assets as "a comprehensive vision of what young people need in the first two decades of life to become healthy, caring, responsible, and contributing members of our society" (Benson, Roehlkepartain, & Leffert, 1997, p. 15). Search Institute contends that asset development is a continuous process that children proceed through and is an interaction of both nature and nurture aspects of development. Natural development is the development of children due to their genetic makeup. Development by means of nurturing is due to children's upbringing and life experiences. At the very early stages of development, (birth – 2 years), external assets are a necessity as they lay the foundation for building the internal assets. It is argued that the more developmental assets a child is in possession of, the more healthy, caring, responsible, and contributing member of society he or she will be (Benson et al., 1997).

The asset framework is divided into two dimensions, external assets and internal assets. External assets are:

factors that surround young people with the support, empowerment, boundaries, expectations, and opportunities that guide them to behave in healthy ways and to make wise choices. These assets are provided by many people and social contexts, including families, schools, neighbors, religious congregations, and organizations. (Benson et al. 1997, p. 16)

Internal assets are:

the commitments, values, competencies, and self-perceptions that must be nurtured within young people to provide them with internal compasses to guide their behaviors and choices. The four internal-asset categories are commitment to learning, positive values, social competencies, and positive identity. (Benson et al., 1997, p. 16)

For the purposes of this study, internal assets were the focus, concentrating on assets from 3 of the 4 categories: positive values, social competencies, and commitment to

learning. These 3 categories were selected for study because they included assets that were cited in anecdotal claims by teachers and in research studies examining school gardens. Positive values are “important internal compasses to guide children’s priorities and choices.” Social competencies are assets that develop the “personal and interpersonal skills children need to negotiate through the maze of choices, options, and relationships they face.” A commitment to learning is defined as a “development of intellectual curiosity and skills to gain new knowledge” (Benson et. al. 1997, p. 18). From these three categories, four specific assets; responsibility, interpersonal competence, achievement motivation, and school engagement were focused on and whether children using and participating in a school garden gain these assets. These assets were chosen because they represented the type of benefits found by educators and school garden researchers to be evident in students after participating in school garden programs.

### **Positive Values**

Values are defined as “internal compasses that guide people in developing priorities and making choices” (Benson et al., 1997, p. 65). The positive value component of the asset framework focuses on both values that affect others as well as values that develop personal character. The development of personal character is a process that does not occur over night. Children begin developing character during infancy and continue through childhood. The intentional nurturing of these character skills is necessary if children are to develop positive values such as caring, equality and social justice, integrity, honesty, responsibility, and restraint (Benson et al., 1997). For the purposes of this study, responsibility was the asset focused on.

**Responsibility.** Responsibility is an asset that children develop when they learn to accept and take personal accountability (Benson et al., 1997). Webster's defines responsibility as "the quality or state of being able to answer for one's conduct and obligations" (Mish, 1996, p. 998).

### **Social Competencies**

Social competencies are skills that help children cope with problems they may encounter as they experience situations they are unfamiliar with or pose some threat to their well being. Building and developing social competencies enables children to "deal with the many choices, challenges, and opportunities they face in life" (Benson et al., 1997, p. 71). Assets dealing with social competencies include planning and decision-making, interpersonal competence, cultural competence, resistance skills, and peaceful conflict resolution. The asset of interpersonal competence was examined in this study.

**Interpersonal competence.** Interpersonal competence refers to a child's ability to interact with adults and peers as well as to make friends. Children with interpersonal competence are also thought to be able to empathize, have sensitivity, and are able to articulate their feelings to others (Benson et al., 1997; Scales & Leffert, 1999).

### **Commitment to Learning**

Learning is a lifelong process that neither begins nor ends with formal schooling. Curiosity is natural to children and as they grow up, this curious nature can either be enhanced or may wane. A commitment to learning is an asset that will

instill in children a desire to learn – not only academics, but other skills that may hold some extracurricular interest to them. A commitment to learning is a skill that engages children's curiosity and encourages learning throughout childhood and on into adulthood. Assets that make up the commitment to learning category are achievement motivation, school engagement, homework, bonding to school, and reading for pleasure (Benson et al., 1997). Each of these assets works to encourage learning, however, for the purposes of this study the assets of achievement motivation and school engagement were studied.

**Achievement motivation.** Achievement motivation is a young person's motivation to do well in school. Students' motivation to achieve is necessary for them to have vocational success. Achievement motivation in children is usually related to their sense of pride in their ability and sense of fulfillment (Benson et al., 1997).

**School engagement.** The other commitment to learning asset is school engagement. Scales and Leffert (1999, p. 122) define school engagement as the "feeling of connectedness to school." Theoretically, if students feel like they are part of the school and have a vested interest in the school, their commitment to learning will increase as will their performance in school.

These four assets – responsibility, interpersonal competence, achievement motivation, and school engagement – were chosen as dependent variables for this study because of their mention in anecdotal articles, research findings, and interviews with teachers. When assessing positive youth development in terms of assets, it is not

whether students have a higher level of responsibility per se than others, it is whether a student is in possession of that asset entirely. Search Institute contends that the more developmental assets a child is in possession of, the more healthy, caring, responsible, and contributing member of society he or she will be (Benson et al., 1997). Therefore, this study examined whether students participating in school garden programs had possession of any of these four assets.

### **Student Attitudes Toward Science**

While research studies have explored students' attitudes toward school, and several educators have remarked at how well the garden lends itself to teaching science and improving science skills and knowledge (Gwynn, 1988; Nelson, 1988; Oehring, 1993; Stetson, 1991), no study to date has examined the effects of a school garden experience on students' attitudes toward science. Having positive attitudes toward science has been shown to increase a students' interest in science and led them to take more science courses (Farenga & Joyce, 1998; Simpson & Oliver, 1990). Students' attitudes toward science are usually high in elementary school, but tend to become more negative as they progress to higher grades (Ayers & Price, 1975; Yager & Penick, 1989). Stimulating interest in science at an early age may increase students' interest in science as they continue through school. Theoretically, a school garden may be a place that interest in science is stimulated. The following section summarizes the current research on students' attitudes toward science and how these attitudes may be influenced.

The three major goals of science instruction as stated by Ayers and Price (1975, p. 311) are "a development of scientific literacy, a positive attitude toward

science, and the development of an understanding of and ability to use the scientific method." They add that in order for a person to develop scientific literacy and to understand and use the scientific method, they must first have a positive attitude toward science. To change students' attitudes toward science, an understanding of how students view science is necessary.

In a study of science related experiences, Farenga and Joyce (1997) found that young boys had a significantly higher number of science related experiences than girls. They suggested that the high number of experiences boys had provided them with "an *a priori* sense of comfort, curiosity and competence in science – or 'science sensibility' ... not enjoyed by most young girls" (Farenga & Joyce, 1997, p. 565). The researchers added that out-of-school science experiences are becoming recognized as an important building block for the foundation of science interest and achievement. Since girls usually have less science-related experiences than boys, this may account for the under representation of girls in science (Farenga & Joyce, 1997; Fox, 1976; Kahle & Lakes, 1983; Kahle, Parker, Rennie, & Riley, 1993).

Farenga and Joyce (1998) also conducted a study of high-ability boys and girls ages 9–13 and found that attitudes toward science are more predictive of science course selection for girls than for boys. Their findings suggest that females with more positive attitudes toward science are more likely to have a greater interest in science classes. This study also showed that girls' poor attitudes toward science are a factor in the low number of science courses they take and this subsequently limits their aspirations in science-related careers. Farenga and Joyce contended that when these findings are examined in light of research that finds sex-role stereotyped career

interests are in place by the second grade (Silverman, 1986), efforts need to be taken to improve girls' interest in and attitudes toward science. The researchers recommended that parents engage their children in activities that help them recognize the importance and relevance of science in their everyday lives. Additionally, they suggested that informal science activities may help provide prior experiences that can help foster an interest and a positive attitude toward science for girls and boys alike. Farenga and Joyce also suggested that educators should make science more appealing through hands-on, inquiry based activities.

Recent research concerning the gender differences in science achievement have suggested that these differences begin to emerge in middle school and are usually set by the time students reach their senior year of high school (American Association of University Women [AAUW], 1992; Linn & Hyde, 1989; Oakes, 1990). Additionally, these studies have also found that female high school students enroll in fewer advanced science courses, have lower test scores and choose fewer science-related careers than their male counterparts (AAUW, 1992, Oakes, 1990). In response to these studies, Catsambis (1995) examined gender differences in science attitudes and achievement among a national sample of eighth-grade students. Results from this study indicated that females from this sample did not have lower science achievement tests scores, grades, and class enrollment than their male classmates. However, this study did find that female students had less positive attitudes toward science, tended to participate in fewer science-related extracurricular activities, and were less interested in science-related careers than the males in their grade.

In addition to examination of gender differences among attitude, achievement and aspirations toward science and related careers, Catsambis (1995) explored differences among ethnic groups. The study found that minority students have very positive attitudes toward science despite their low test scores. This disparity among attitudes and scores is thought to be the result of external environmental factors such as family, community, and school being more important to achievement than are attitudes. The limited number of females and minorities in science-related fields may be due, in part, to poor attitudes toward science and poor performance in science. Females' poor attitudes toward science were thought to be related to gender-role perceptions and a belief that the science field is male dominated (Handley & Morse, 1984). Additionally, Farenga and Joyce (1998, p. 250) state that "young high-ability girls perceive the role of a scientist [as] not conform[ing] to their social sphere of possible options."

In conclusion, Catsambis suggested that efforts to improve students' achievement and attitudes toward science should begin in the elementary school years. These efforts should also be focused on gender and ethnic groups such that steps are taken to improve females' attitudes toward science, interest in related careers and to improve the achievement scores of minority students so that they each have an equal opportunity for science-related careers.

In another study exploring science attitudes, Simpson and Oliver (1990) carried out a comprehensive 10-year longitudinal study with students in the 6<sup>th</sup>, 7<sup>th</sup>, 8<sup>th</sup>, 9<sup>th</sup>, and 10<sup>th</sup> grades to determine the major influences on attitude toward and achievement in science. Three major categories of independent variables were

identified and addressed in the study. These variables were related to home, school, and individual characteristics. This 10-year study yielded many important findings about attitudes and achievement in science. With this population of students, science attitudes decreased each year. Attitudes also decreased as students progressed from the beginning of the school year to the middle of the school year. This decline in science attitudes also occurred across the grades from sixth through tenth and became neutral in grade ten. Attitudes toward science were consistently higher among males. In terms of achievement motivation in science, the results were similar to those for attitudes, with a decline within each year and across the grades, and by grade ten becoming neutral. Females had consistently higher achievement motivation scores in science.

Simpson and Oliver (1980) also found a strong positive correlation between students' attitudes toward science and their friends' attitudes toward science. This relationship was most pronounced in the ninth grade. The researchers suggested that this phenomenon was most likely due to the importance of friendships for adolescent students, and thus students were more likely to be influenced by their peer groups. School, in particular the classroom, was found to have the strongest influence on attitudes toward science. Individual and home factors also contributed significantly to students' attitudes, but it was the classroom setting and curriculum that most strongly accounted for students' decisions to embark on future science courses. In contrast, students' self-related variables – science self-concept, achievement motivation, and science anxiety – were the strongest predictors of a students' achievement in science. Further exploration found that attitudes toward science play

a critical role in determining the amount of science a student experiences in future endeavors.

Simpson and Oliver (1990) also stated that if students enter middle school with positive attitudes toward science and have positive initial experiences with science, they are more likely to continue taking and being successful in additional science courses. They warned that if students receive little support from home, are not exposed to science in elementary school, and do not have positive initial experiences in middle school science courses, they are unlikely to continue taking science courses. These students will then, in most cases, end high school with little knowledge of and commitment to science.

Yager and Yager (1985) carried out a study to determine the perceptions of science held by third-, seventh-, and eleventh-grade students. They found that one third of elementary school students perceived that their teachers really like science, compared to the 75% of secondary school students having the same perception. In the third grade, students indicated that their teachers make science exciting. This was also true for secondary school students but at decreasing levels. Sixty percent of third graders perceived that their teachers know much about science, 65% of seventh graders, and 80% of eleventh graders perceived the same. Close to half (40%) of third grade science teachers were perceived as willing to admit they do not know the answers to science questions. This figure drops around 20% for seventh and eleventh grades, respectively.

This study also explored the perception of science classes as fun, exciting, and interesting. More than half of the third graders reported their science classes as being

exciting, fun, and interesting. This figure dropped to less than 50% for the upper grade levels. Similarly, few third graders found their science class to be boring. In contrast, over one-fourth of seventh graders and one-third of eleventh graders found science classes to be boring.

Studies have also explored how exemplary science programs impact students' attitudes toward science. Exemplary programs are those that are recognized by the National Science Teachers Association (NSTA) Search for Excellence in Science Education program. Exemplary programs as identified by the NSTA are those programs that are

locally and personally relevant, they focus on applications and technology, and they give experience with the formulation of insightful, long-term resolutions of our time. Furthermore, they illustrate science as an ongoing and human enterprise and they provide students with direct experiences with ideas, materials, use of information, and making decisions. They focus on personal, societal, and career goals. Finally, they begin at the level of impact of science on the community rather than ending at this level. (Yager & Penick, 1989, pp. 55-56)

Studies with students in exemplary science programs found that students in such programs have more positive attitudes toward science than do students in regular programs. These studies have also found that in contrast to other students, exemplary science students' attitudes do not worsen over time (Yager, 1988; Yager & Penick, 1989).

One such study of exemplary science programs carried out by Yager and Penick (1989) showed that students in exemplary programs perceived science as being fun, exciting, and interesting. Students in these programs also perceived science as being less boring. Exemplary program students, in comparison to regular science students, felt that they were more comfortable in their science classes,

believed that their teachers liked for them to ask questions and share ideas, and viewed their teachers as being able to make science exciting. This study also found that exemplary program students had a more realistic view of science than did regular program students and that their science classes prepared them to make choices.

A study conducted by Basham (1994) looked at how the use of an interdisciplinary environmental unit, which included lessons on pollution, rainforest devastation, recycling, and Earth appreciation for fourth-grade students, affected their attitudes toward science and learning. Students participated in activities that allowed them to be active participants in solving problems related to the environmental lessons. Basham found that after participating in the two-week interdisciplinary program about the environment, fourth-grade students had more positive attitudes toward science after the program than before the program.

Yager and McCormack (1989, p. 49) found that "students report that typical [science] courses lessen curiosity, excitement, ability to create explanations, ability to reason and to make critical decisions based on evidence." Science classes that limit students' creativity are usually found to limit many of the qualities that are inherently scientific. Yager and McCormack stated that if science attitudes are positive and students have opportunities to be creative, students' understanding and knowledge of science will be enhanced. Furthermore, they stated that most traditional science programs do not allow for creativity and even discourage creativity. Traditional science programs usually focus on teaching students information acquisition instead of on instructional techniques that foster creative thought and positive attitudes. Yager and McCormack also found that many science teachers believe that basic

science information and process skills provide enough knowledge for students needing science and that positive attitudes are not that important.

In response to the way science classes are usually taught, Yager and McCormack (1989) developed a model that explains the logical way that science should be taught. They contend that science teaching should begin with the applications and connection to the real world. This understanding of how science is relevant to the real world and to everyday life will lead students to see the need to study the processes and information pertaining to science. To teach students the facts and processes first is to make them differentiate between "real world science (based on personal experiences) and school science (based on the information included in textbooks and course outlines)" (Yager & McCormack, 1989, p. 50). Ideally, students need to be taught all aspects of science (applications, facts, and processes), in traditional science courses this rarely occurs.

In summary, instilling positive attitudes toward science in children must start at an early age (Catsambis, 1995; Farenga & Joyce, 1998; Simpson & Oliver, 1990; Yager & McCormack, 1985; Yager & Yager, 1989). These researchers have also found that for students to continue to have an interest in science and to explore the possibility of science-related careers, positive science attitudes must be stimulated in elementary school. Suggestions for stimulating interest and promoting positive attitudes include providing out of school science experiences (Farenga & Joyce, 1997), informal science activities, and hands-on and inquiry-based science activities (Farenga & Joyce, 1998). All of these suggestions can be carried out in a school garden. School gardens are usually outside the classroom and may seem to students

to be separate from their indoor science lessons. These out of classroom experiences in the garden may give boys and girls equal opportunities to experience science in a fun and exciting way. Farenga and Joyce (1998) suggest that these experiences are ways to stimulate positive science attitudes and increase students' interest in science. Additionally, Simpson and Oliver (1990) found that the classroom and curriculum are very influential on students' attitudes toward science. A school garden is a part of the classroom and curriculum, and since a garden can provide hands-on experiences, informal science activities, and out of school experiences as suggested by researchers, this type of classroom experience may stimulate students' interest in and promote positive attitudes toward science.

Although research has shown that students' attitudes and perceptions of science are positive in the third grade, these usually decline as the student progresses to the upper grades (Simpson & Oliver, 1990; Yager & Yager, 1985). Studies of students in exemplary science programs have shown, however, that students' attitudes toward science were positive and continued to stay positive as they moved up in grade level (Yager & Penick, 1989). Yager and McCormack (1989) suggest that creativity in school science programs and a focus on the real-world connections and applications can provide students with positive experiences with science. Exemplary programs were those that stimulated curiosity, made real world connections, and helped students see the impact of science in their lives and in the world. School gardens, if designed and used properly, can give students the opportunity to experience creative science, real world applications, and understand how science relates to them. Gardens are inherently scientific and, as such, teachers often use them

to enhance science lessons. Using gardens for the purposes of teaching science in an informal, more exciting manner may be a way to stimulate interest in science and provide students with the positive attitude toward science that is needed to help students stay interested in science and possibly even make a career out of science.

### **Student Attitudes Toward the Environment**

Promoting positive environmental attitudes in elementary students through the use of school gardens has been witnessed by many educators (Anon., 1992; Barron, 1993; Canaris, 1995; Dwight, 1992; Kutsunai, 1994; Montessori, 1912) and several researchers (Barker, 1992; Alexander et al., 1995; Skelly, 1997; Waliczek, 1997). All but two Florida elementary school teachers surveyed in a study used school gardens to teach environmental education (Skelly & Bradley, 2000). Most of the research conducted with children's environmental attitudes has been conducted with students participating in environmental education programs.

Ramsey and Rickson (1976) argue that increasing students' knowledge about the environment is necessary for changing students' attitudes toward the environment. Knowledge and attitude are both necessary for making informed decisions about environmental issues. Research has shown that environmental education programs do promote positive environmental attitudes in students (Bradley et al., 1997; Bryant & Hungerford, 1977; Dresner & Gill, 1994; Jaus, 1982, 1984; Ramsey & Rickson, 1976). Ramsey, Hungerford, and Volk (1992) argue that education concerning environmental issues is necessary if a society is to carry out environmentally responsible behavior. Cohen and Horm-Wingard (1993) found that students in kindergarten begin to develop attitudes about the environment at an early age. They

concluded from these findings that environmental education, even at an early age, can result in positive environmental attitudes that may carry on into adulthood. Kelly (1994) believes schools have the responsibility of educating children about the environment and how to ultimately care for and protect the environment.

Harvey (1989) found that children's contact and experiences with nature can affect their environmental dispositions. Harvey found, in a study with 845 (8- to 11-year-old) children that past experiences with nature positively affected students' attitudes toward the environment. This study also revealed that any experience children had with vegetation was important to the prevention of poor environmental attitudes in children.

Studies have also found that time in nature is a factor when developing students' environmental attitudes. The amount of time that students participate in wilderness programs was found by Shephard and Speelman (1985) to affect students' environmental attitudes. One other study of nature summer camps found that one or more weeks in contact with nature was enough time for students to develop positive environmental attitudes (Dresner & Gill, 1984).

Jaus' (1984) conducted a study of whether two hours of environmental instruction affected students attitudes toward the environment and their retention of these attitudes. Jaus found that two hours of instruction were effective in developing positive environmental attitudes in young children (third graders). Jaus also found that these attitudes were retained over time (after two years).

Studies of teachers and school gardens and anecdotal testimony about school garden benefits show that teachers are using school gardens to teach students about

the environment. Recent studies have shown that school gardens can instill positive environmental attitudes in students that use them (Skelly, 1997; Waliczek, 1997). School gardens are places where teachers can teach environmental education and students can have contact with nature. This combination of education and experience is why a garden may be an ideal place to improve students' attitudes toward the environment.

### **Summary of Literature**

Gardening is a very popular hobby that has been shown to have beneficial effects on people who garden. These benefits include peace and tranquility, a sense of control, and relaxation (Butterfield & Relf, 1992). Additional benefits that people gain from gardening include the enjoyment of producing food, learning, enjoyment of the outside, a sense of accomplishment, and a sense of fascination (Kaplan, 1973). Other studies have shown that gardening can also increase self-esteem and self-actualization for certain ethnic groups (Waliczek et al., 1996). With gardening being so popular and so beneficial, many primary and secondary education schools, past and present, have recognized the benefits gardening may have on students and therefore utilize school gardens.

School gardens have been in existence for centuries and have spanned the globe. School gardens were thought to be places where students could learn about plants, agriculture, nature, and almost any subject being taught in schools (Bachert, 1976). Early educators and professionals also recognized that school gardens could also be a place to foster moral development in terms of patience, responsibility, care and nurturing, and appreciation for nature (Montessori, 1912; Bachert, 1976). Even

today, educators recognize the benefits children can gain from school gardens. A review of anecdotal testimony of educators using school gardens shows that educators discuss five categories of school garden benefits. Moral development in terms of cooperation, patience, self-control, pride, leadership, an understanding of and appreciation for work, and responsibility were all cited by educators as benefits of students' school garden experiences (In Virginia, 1992; Becker, 1995; Berghorn, 1988; Braun, 1994; Canaris, 1995; Craig, 1997; Davies, 1995; Dwight, 1992; Gwynn, 1988; Neer, 1990; Pivnick, 1994). Educators also recognized that students were benefiting academically from school garden experiences. Teachers discussed how school gardens made learning fun and exciting for their students, while at the same time helping in teaching them about problem-solving, observing, plants, weather, social studies, math, science, and nutrition (Braun, 1989; Canaris, 1995; Gwynn, 1988; Oehring, 1993; Stetson, 1991).

Teachers also recognized that school gardens were places where students could learn to be a part of their community as well as feel a part of their community (In Virginia, 1992; Barron, 1993; Braun, 1989; Canaris, 1995; Dwight, 1992; Kutsunai, 1994; Neer, 1990). Educating children about nature and giving them opportunities to be in contact with nature were other benefits cited by teachers. Educators contend that gardens help children connect and bond with nature, while also teaching them how to nurture and respect living things. Gardens are places that can help children develop environmentally positive attitudes (Becker, 1995; Canaris, 1995; Chawla, 1994; Gwynn, 1988; Heffernan, 1994; Pennington, 1988; Pivnick, 1994; Stetson, 1991). Many of these benefits are the observations of a single teacher

with his/her students. However there is documented research that supports the claims of these teachers.

Research with teachers has shown that teachers use school gardens to enhance the learning of their students, promote experiential learning, and teach environmental education (DeMarco, 1999; Skelly & Bradley, 2000). Studies have also found that using school gardens to teach does in fact improve students' learning (Sheffield, 1992) and environmental dispositions (Alexander et al., 1995; Barker, 1992; Skelly, 1997; Waliczek, 1997; Wotowiec, 1975). The research exploring the benefits of school gardens has not, however, examined the role of school gardens in the development of school children in terms of youth developmental assets, attitudes toward science, and environmental attitudes within the context of cognitive developmental and educational theories. Exploring these variables within a theoretical framework was the purpose of this study.

Youth developmental assets are skills children need to become healthy, productive, and responsible adults. The Search Institute has carried out extensive research documenting what assets are and how they contribute to the development of children and adolescents (Benson et al., 1997). Four assets, responsibility, achievement motivation, school engagement, and interpersonal competence were focused on for this study. These assets were investigated because they have been observed by teachers using school gardens.

Many teachers and researchers indicate that school gardens are being used to teach science. Using a garden to teach science may ultimately influence children's attitudes toward science. Students' attitudes toward science have been the subject of

much research. Studies have been conducted to determine how students feel about science and what their attitudes toward science mean for their future in science. These research studies have found that efforts need to be taken in elementary school to improve students' attitudes toward science. If this does not happen, students' attitudes toward science decline as they progress through school. These declining attitudes affect how many science classes students enroll in and ultimately, whether students consider careers in science (Catsambis, 1995; Farenga & Joyce, 1998; Yager & McCormack, 1985; Yager & Yager, 1989). Offering classes that make science fun, exciting, related to the real world, and informal can result in developing positive attitudes toward science in students. School gardens can provide teachers with a forum to enhance science lessons, make science creative, fun, and related to the real world.

A common theme running through historical, anecdotal, and research literature on school gardens is that school gardens provide children with a sense of nature and reasons to care for nature and the environment. Positive attitudes toward the environment are important factors for making informed decisions about environmental policies and issues (Ramsey & Rickson, 1976). Studies have shown that contact with nature, even in small amounts, can positively influence a child's attitudes toward the environment (Dresner & Gill, 1984; Harvey, 1989; Shephard & Speelman, 1985). Additionally, minimal instruction about the environment with third graders was shown to be effective in developing and retaining positive attitudes toward the environment (Jaus, 1984). Research exploring how school garden experiences impact students environmental attitudes has shown that gardens do

indeed result in students having more positive environmental attitudes (Skelly, 1997; Waliczek, 1997).

### **CHAPTER 3 METHODOLOGY**

The goal of this study was to explore the benefits of school gardens to the students participating in them. This chapter describes the procedures followed to develop teacher and student surveys, collect data, develop a typology of school garden intensity, and a discussion of univariate statistics.

#### **Participant Selection**

The participants for this study were drawn from elementary schools in Florida participating in the Florida School Garden Competition and the Project SOAR (Sharing Our Agricultural Roots) school gardening program. The Florida School Garden Competition is a statewide program developed by the University of Florida's Department of Environmental Horticulture and the EPCOT® International Flower and Garden Festival. The competition invites teachers in elementary schools throughout Florida to showcase their school gardens and compete for prizes. The Florida Department of Education provided an address list of all elementary schools in the state. A promotional brochure for the 1999-2000 competition and an interest-information card were sent to all elementary schools in Florida using this address list. Interested teachers or administrators with school gardens wishing to participate in the competition returned the interest-information card to the Department of Environmental Horticulture at the University of Florida. Included on the interest-

information card was a question asking teachers if they would be interested in participating in a University of Florida study examining the benefits of school gardens to students. A statement followed the question informing teachers that their willingness to participate or not participate in no way affected their chances in the Florida School Garden Competition. Third grade students were selected to be participants in this study for several reasons. Students in third-grade are between the ages of nine and ten. At this age, students are in Piaget's concrete operational stage, which is characterized by a child's ability to logically solve concrete or hands-on problems. Since this logical thinking is tied to physical reality, instruction that is comprised of problem solving, experimentation, concrete learning activities, and active exploration and interaction with adults, children, and materials is recommended. Theoretically, school garden instruction can provide these types of learning experiences and would be most effective for children in the concrete operational stage. The other reason third grade students were chosen to participate in this study was because the science Sunshine State Standards for third-grade include the life science topics that deal specifically with plants. Third-grade teachers may use the garden to address these standards.

After interest-information cards were received from 130 teachers, encompassing grade levels from Kindergarten to sixth grade, the researcher contacted all third grade teachers who indicated a willingness to participate in the study to solicit their and their students' participation. Twenty-six third grade teachers from the Florida School Garden Competition agreed to participate in this study. These schools were located throughout the state of Florida.

The remaining three teachers participating in the study were drawn from a group of schools participating in the Project SOAR school garden program. Project SOAR is an agricultural outreach program started by professors at the University of Florida's Everglades Research and Education Center with elementary schools in Palm Beach County Florida. The SOAR program works with participating schools to build school gardens or miniature plant nurseries and to supply necessary tools and equipment required to run the garden or nursery. The program also assigns a "garden-knowledgeable" person to each school to assist in the development, maintenance, and management of the school garden (Nagata & Raid, 1997, p. 403). A list of 23 participating schools was obtained from the professors at the Everglades Research Center and calls were made to schools to solicit participation in this study. Only three of the twenty-three schools participating in Project SOAR had third grade students participating in the program. The teachers of these three third grade classes agreed to participate in this research project. The final participant group for this study consisted of 29 teachers and 466 students (Table 3-1). Most of these schools were located in residential areas (85.7%). The remaining schools were located in rural areas (14.3%). No school reported being located in commercial sectors.

### **Measuring the Dependent Variables**

A student survey was constructed to measure the dependent variables of youth developmental assets: responsibility, achievement motivation, school engagement, and interpersonal competence; students' attitudes toward science; and students' attitudes toward the environment. Established scales were used to measure each of these variables.

**Table 3-1. Number of classes, teachers, and students participating in the study.**

School	Classes	Teachers	Students
Elementary School 1	1	1	2
Elementary School 2	1	1	3
Elementary School 3	1	1	21
Elementary School 4	1	1	10
Elementary School 5	1	1	12
Elementary School 6	1	1	18
Elementary School 7	1	1	16
Elementary School 8	1	1	19
Elementary School 9	1	1	49
Elementary School 10	1	1	16
Elementary School 11	3	3	46
Elementary School 12	2	2	23
Elementary School 13	1	1	15
Elementary School 14	2	1	19
Elementary School 15	2	2	37
Elementary School 16	1	1	16
Elementary School 17	1	1	23
Elementary School 18	3	3	52
Elementary School 19	1	1	9
Elementary School 20	1	1	8
Elementary School 21	1	1	26
Elementary School 22	1	1	26
<b>Total</b>	<b>28</b>	<b>29</b>	<b>466</b>

To assess the youth developmental assets of responsibility, school engagement, achievement motivation, and interpersonal competence, items from the Search Institute's *Profiles of Student Life: Attitudes and Behaviors* measure (Scales & Leffert, 1997) were used. This measure is a 156-item self-report survey for 6<sup>th</sup> through 12<sup>th</sup> grade students. Twelve items pertaining to the assets under investigation were selected from this measure and altered slightly so that they would be understandable to third grade students. The *Profiles of Student Life* survey only contained two statements to measure responsibility, therefore two additional

statements were developed. These additional statements were developed using information gathered from the literature and interviews with teachers.

To assess students' attitudes toward science, the *Attitudes, Preferences, and Understandings* (1988) scale was used. This scale was developed by researchers at the University of Iowa by taking questions from the National Assessment of Educational Progress batteries. Researchers have used this instrument with several thousand students from grade three to young adult. This assessment tool was developed to measure students' attitudes toward their science teachers, science classes, usefulness of science study, and perceptions of being a scientist (Yager & McCormack, 1988). Ten questions from three of the four domains, those measuring attitudes toward science teachers, science classes, and usefulness of science study were used. Since this study was concerned with the benefits of school gardens to students, five questions related to school gardens were developed. These garden questions were patterned after the *Attitudes, Preferences, and Understandings* items.

To measure the final variable of interest, attitudes toward the environment, two measurement tools were used. Items to measure students' environmental attitudes were taken from the *Children's Environmental Response Inventory* (CERI) developed by Bunting and Cousins (1985) and an environmental attitude scale developed by Jaus (1984). These two measures were used to obtain attitudes on a wide range of environmental attitudes. Seven items were taken from the CERI and Jaus' scale to make up the environmental attitude measure for this study.

Items from each of the measurement tools were compiled into a single survey for students. The answer scales for several of the questions from each measurement

tool were changed so that all the questions on the student survey would have the same answer scale for ease of reading and comprehension. The wording for several of the questions was also altered slightly to accommodate for the change in the answer scale and to match the reading level of third grade students. The answer scale used for each question on the student survey was a Likert-type scale with five responses: always, most of the time, half the time, sometimes, and never. In addition to these responses, a graphical representation of each word/phrase was developed. One study conducted by Cook, Church, Ajanaku, Shadish, Kim, and Cohen (1996) found that graphical representations of volume helped second grade students understand the answer scale more easily. For the answer scale on the student survey, a graphical representation of a daisy with eight petals was developed and used. The number of petals on the daisy corresponded to the answers: always (eight petals), most of the time (six petals), half the time (four petals), sometimes (two petals), and never (no petals, just the center of the daisy) (Appendix A). Pilot testing of the survey indicated that the flower scale helped students understand the answer and students did not answer the question based on their preference for the flower with all the petals versus the flower with fewer or no petals. These responses were then coded such that 5 = always, 4 = most of the time, 3 = half the time, 2 = sometimes, and 1 = never.

In addition to questions related to the variables of interest, demographic questions were included on the student survey. These demographic questions included student's name, teacher's name, birthday, gender, and ethnicity. The teacher's name was included so that the student surveys could be matched with their teacher's survey for subsequent analyses. Students were asked to give the month,

day, and year of their birthday. This information allowed for a more accurate measure of age in terms of month and year. Students were also asked to mark their ethnicity in terms of Black or African American, Asian, Hispanic, White, or Indian or Native American. The terms "Black" and "Indian" were used along with their more politically correct terms, as pilot testing of the survey indicated that some students did not understand the politically correct terms.

After data collection, each scale measuring the dependent variables was factor analyzed using principle components extraction to assess the makeup and reliability of the scales. Factor analysis of the twelve items from the *Profiles of Student Life* scale, measuring youth developmental assets, produced four subscales, of which only the scale measuring responsibility had an index reliability that could be used (Table B-1, Appendix B). The other items measuring school engagement, achievement motivation, and interpersonal competence did not measure what they were reported to measure and were, therefore, not used for subsequent analyses in this study. Further analysis of the items loading on the responsibility factor showed that these factors were correlated and could be used as one scale (Table B-2, Appendix B). The responses to each statement in the responsibility scale were summed and the mean taken to represent the degree of responsibility the students indicated. This mean score was used as the dependent variable of responsibility. Reliability for the responsibility scale was established via Chronbach's alpha. The responsibility scale had an alpha of .53, a mean of 4.46, and a standard deviation of .55. The mean for each scale was taken to retain the original metric of the responses and for ease of interpretation.

Items from the *Attitudes, Preferences, and Understandings* scale, measuring students' attitudes toward science, were factor analyzed and produced two subscales: attitudes toward science and the perceived usefulness of science study (Table B-3, Appendix B). Items measuring students' attitudes toward science were analyzed and found to be correlated (Table B-4, Appendix B) as were the items measuring students' attitudes toward the usefulness of science study (Table B-5, Appendix B). The responses to each statement in the attitudes and usefulness scales were summed and the mean taken to represent students' attitudes toward science and perceived usefulness of science study. These mean scores were used as the dependent variables of science attitude and science usefulness. The science attitude scale had an alpha of .90, a mean of 3.96, and a standard deviation of 1.04. The usefulness of science study scale had an alpha of .65, a mean of 3.76, and a standard deviation of .87.

Items measuring students' attitudes toward the garden were patterned after the items in the *Attitudes, Preferences, and Understandings* scale. The responses to each statement in the garden scale were summed and the mean taken to represent students' garden attitudes. The garden items were factor analyzed and all items loaded on one factor (Table B-6, Appendix B). Correlational analysis showed these items to be correlated (Table B-7, Appendix B). The attitudes toward the garden scale had an alpha of .92, a mean of 4.19, and a standard deviation of 1.01.

Items measuring students' attitudes toward the environment, when factor analyzed, produced multiple domains. However, four items dealing with caring for the environment did emerge as a reliable index (Table B-8, Appendix B). These items were found to be correlated (Table B-9, Appendix B) and were combined to

serve as the environmental attitude scale. The three items that did not load on this caring factor were factors that were more abstract and thought to be not fully understood by the third grade students and were therefore not included in the scale. The responses to each statement measuring students' attitudes toward the environment were summed and the mean taken to represent students' attitudes toward the environment. The attitudes toward the environment scale had an alpha of .59, a mean of 4.81, and a standard deviation of .41. Univariate statistics for each scale used in the student survey are reported in Table 3-2.

### **Measuring the Independent Variables**

In this study, the independent variables were conceptualized into three domains: student individual factors, school garden type, and school garden intensity. The student individual factors were the demographic factors of age, gender, and ethnicity. School garden type and intensity were determined from information gathered from a teacher survey. Based on information gained from teachers about their school garden type and intensity, a typology was developed and served as an independent variable.

#### **Individual Factors**

Individual factors were measured from demographic variables. These variables included age, gender, and ethnicity. The mean age of students in this study was 9.01 and all students were enrolled in the third grade. Of the participants, 47.2% were male and 52.8% were female. The majority of the students were white (73.6%), with a small percentage of African American (15.6%), Native American (3.7%),

Hispanic (6.0%), and Asian (1.1%). For subsequent analyses, the ethnicity of the group was divided into white (73.6%) and other (26.4%).

### **Typology of School Gardens**

A typology of school gardens based on garden form and intensity was created from information gained from the teacher survey. Development of this survey was conducted through researcher observations of school garden programs, interviews with teachers using school gardens, and a Delphi Technique interview with an expert panel of teachers using school gardens. The survey contained 19 questions designed to elicit information from teachers about their school gardens. This information was used to develop a typology of school garden programs.

A typology is a type of model. A model, in terms of research, is a way to summarize data for a given set of observations (Lunneborg, 1994). Bailey (1994) defines a typology to be a type of classification that is multidimensional and conceptual in nature. It is a classification method that orders data to create ideal types. Classification is the ordering of entities into groups or classes based on their similarities. Classification seeks to minimize within-group variance while maximizing between-group variance. This allows each group to be as homogeneous as possible, while the difference between groups remains as heterogeneous as possible.

Table 3-2. Univariate statistics for dependent variables scales.

Statement	5	4	3	2	1		
	N	Always %	Most of the time %	Half the time %	Sometimes %	Never %	M SD
<b>Responsibility scale</b>	448						4.46 .55
I care how well I do in school.	447	86.4	11.4	1.1	1.1	0.0	4.83 .48
At school, I try as hard as I can to do my best work.	447	79.4	17.4	2.2	0.9	0.0	4.75 .53
I accept responsibility for my actions when I make a mistake or get in trouble.	440	43.0	36.8	8.2	9.3	2.7	4.08 1.06
I do my best even when it is a job I do not like to do.	447	51.5	28.4	7.6	9.2	3.4	4.15 1.11
<b>Science attitude scale</b>	448						3.96 1.04
Science time is fun.	448	47.5	25.2	11.2	9.6	6.5	3.98 1.25
Science makes me want to learn more.	447	51.2	19.5	11.4	13.6	4.3	4.00 1.25
I like science.	447	49.4	23.7	10.7	10.7	5.4	4.01 1.23
Science time is exciting.	447	38.3	28.6	13.9	13.6	5.6	3.80 1.24
Science time is boring. <sup>1</sup>	446	7.6	7.0	8.3	29.6	47.5	4.02 1.24
<b>Usefulness of science study scale</b>	448						3.76 .87
Science time helps me test ideas I have.	442	42.8	26.5	13.3	11.5	5.9	3.89 1.24
Science time teaches me skills to use outside of school.	442	45.2	25.6	12.7	11.3	5.2	3.94 1.22

<sup>1</sup>Scores for this statement were recorded so that a score of 5 meant students never found science boring and 1 meant students always found science boring.

Table 3-2 continued. Univariate statistics for dependent variables scales.

Statement	N	5 Always %	4 Most of the time %	3 Half the time %	2 Sometimes %	1 Never %	M	SD
<b>Usefulness of science study scale <i>cont'd.</i></b>								
My teacher wants me to ask questions when we do science.	441	39.0	21.5	12.9	21.3	5.2	3.68	1.32
Being a scientist would be fun.	446	40.6	18.6	13.0	15.7	12.1	3.60	1.45
Being a scientist that studies plants would be fun.	446	44.2	20.6	12.6	14.6	10.1	3.70	1.40
<b>Environmental attitude scale</b>								
I think people should take care of plants and animals.	447						4.81	.41
	445	94.2	3.8	1.1	0.9	0.0	4.91	.40
I think people should try to recycle.	443	86.9	8.4	3.2	1.4	0.2	4.80	.57
I think people must take care of the environment.	442	91.0	6.1	1.8	1.1	0.0	4.87	.47
I think newspapers should be recycled.	445	81.3	8.8	4.5	3.8	1.6	4.64	.86
<b>Garden attitude scale</b>								
Working in the garden is fun.	445						4.20	1.01
	443	65.2	17.8	7.7	7.2	2.0	4.37	1.03
Working in the garden makes me want to learn more.	442	52.3	22.6	10.0	10.2	5.0	4.07	1.21
Working in the garden is exciting.	439	57.2	20.3	9.3	10.0	3.2	4.18	1.15
The garden makes learning fun.	440	60.5	16.4	9.8	8.6	4.8	4.19	1.20
The garden helps me learn new things.	439	54.7	21.9	9.1	10.7	3.6	4.13	1.17

Typologies represent type concepts rather than empirical cases, whereas taxonomies are concerned with empirical cases. Typologies, however, lead to an increased understanding of the empirical world (Luloff, 1987). Typologies are often arrived at in the course of an attempt to construct an index or scale (Babbie, 1992). The cells of a typological table become types or type concepts and typologies are characterized by labels or names in their cells and are usually composed of monothetic classes. Monothetic classes are classes containing cases that are all identical on all variables or dimensions being measured (Bailey, 1994). Because typologies involve more than one dimension, the dimensions are usually correlated or related. The dimensions are also typically composed of categorical data, such as nominal or ordinal variables.

Typologies, being a form of classification, are very useful in the social sciences. Classifications provide the basis for conceptualization, language, mathematics, statistics and much more, including social science research (Bailey, 1994). Bailey identifies ten advantages for classification in the social sciences. The first advantage is that classification is a foremost tool for description. A good classification gives the researcher an opportunity to provide an exhaustive and sometimes definitive array of types. This descriptive tool also allows for a quick assessment of how a particular type scores on a particular dimension as well as which types are contiguous to a particular type. The second advantage of a typological classification is the reduction of complexity. Typologies allow the researcher to simplify reality in a way that can be analyzed. It takes a seemingly large amount of data and condenses it into salient types. Identification of similarities and differences

among types are the third and fourth advantages identified. These advantages allow the researcher to either group similar cases or separate dissimilar cases for subsequent analysis. Another reason typologies are important to the social scientist is because they present an exhaustive list of dimensions. A good typology will display an exhaustive set of types as well as the exhaustive set of dimensions on which the types are based. This ensures that the typology is very comprehensive and is able to show the relationship among types and dimensions. Classification allows the researcher to quickly and easily compare types. Typologies also allow for easy appraisal of variation in types. The seventh identified advantage of classification is that types are easily inventoried and located. This also allows for identification of what types are available for analysis. Typological classifications are useful in the social sciences because they provide a format for studying relationships and even the specification of hypotheses concerning such relationships. A final advantage of a typology is the ability to use types for measurement. A researcher can select a type as the criterion and compare how other types relate to this criterion. The type selected may be chosen as the ideal type, an extreme or heightened representation of all dimensions in the typology, and thus allow for analysis as to how other types relate to the ideal type.

The use of school gardens by teachers is a very diverse practice. Many different types, styles, and sizes of gardens exist. Additionally, due to climatic conditions, gardens differ with respect to what and when plants can be grown in a garden. Teachers also use the garden for many differing tasks. Recent research has found that teachers are using school gardens for teaching, social achievement, environmental stewardship, experiential learning, and as a tool to teach a multitude of

subjects (DeMarco, 1999; Skelly & Bradley, 2000). Additionally, in the initial stages of this research study, interviews with teachers and correspondence with a panel of experts indicated that teachers in Florida were using gardens to varying degrees and for varying purposes. Regardless of the type, style, size, location, and use of school gardens, it is important to examine how the use of a school garden may affect the students who use school gardens.

It would be nearly impossible to have a set of teachers create identical gardens and use them in identical ways. In reality, teachers across the country are creating gardens and using them in diverse fashions (DeMarco, 1999; Skelly & Bradley, 2000). In order to assess the impact school gardens may be having on students, it is necessary to set up a means of classifying school gardens. For the purposes of this study, school gardens are referred to as school garden programs. A school garden program encompasses not only the garden itself, but also how teachers and students are using the garden both in and outside the classroom. Due to the diversity of school garden programs throughout schools in Florida, it was determined that a typology of school garden programs would be created on the basis of intensity (high, medium, and low) and form (vegetable, flower, and combination vegetable/flower).

Bailey (1994) defines the one secret to successful classification as being the ability to ascertain the key or fundamental characteristics on which the classification is to be based. For this research project, the first step in determining these characteristics of school garden program intensity was to find out first hand the types of gardens in schools and how these gardens were being used by teachers. In February 1999, two observations of school garden programs were carried out. For

these observations, the researcher went to an elementary school in Florida and observed two teachers each using a different garden. During the observations, the researcher made notes on the location of the garden, type of garden and plants being grown and planted, size of the garden, types of activities in which students participated while in the garden, type of instruction that occurred in the garden, and questions being asked by teachers and students in the garden.

Following the observations, interviews with 10 Florida elementary school teachers were conducted. Teachers who participated in the 1998-1999 Florida School Garden Competition were randomly selected and asked to participate in an interview with the researcher. These teachers were asked numerous questions concerning their school garden programs. The researcher asked questions relating to how long they had been teaching, if they gardened at home, reasons for using a school garden, type of garden at the school, how the garden was used by students, how the garden was used by the teacher both in and out of the classroom, level of involvement of students, amount of time spent in the garden, and experiences related to the garden. The answers to these questions helped to formulate the basic questions that would start another interview process, known as the Delphi Technique.

The Delphi Technique is a process in which an expert panel is identified and then asked a series of questions, each set of questions building on the answers of the previous question set (Dalkey, 1969). For this study, an expert panel of eight teachers was identified and asked to participate in the Delphi Technique interview process. Once the expert panel was assembled, a series of question sets were sent out via email or regular postal mail. The first question set was sent in April 1999. The panel was

given two weeks to return their answers to the researcher. Responses from each question set were summarized and were used to generate the next question set. This process took place four times over a three-month period ending in June 1999.

Information gained from the observations, interviews, and the Delphi interviews suggested a number of possible factors for measuring the intensity of a school garden program (Table 3-3). These factors were organized into questions for the teacher survey.

In addition to factors of intensity, the typology also consisted of the dimension of form of the garden. For the purposes of this study, form of the garden was limited to vegetable garden, flower garden, or a combination of vegetable and flower garden. Vegetable gardens were used by 14.3% of the teachers participating in this study. Flower gardens were being used by 39.3% of the teachers and 46.4% of the teachers were using combination vegetable/flower gardens. Garden forms can be extremely diverse, therefore these categories were set to reduce this reality into a more manageable form.

The typology used in this study was constructed using the dimensions of garden intensity (high, medium, low) based on number of garden-related activities students participated in prior to and while in the garden and garden form (vegetable, flower, combination) (Table 3-4). Figure 3-1 illustrates the distribution of number of activities students participated in prior to and while in the garden. Garden intensity and form were cross tabulated to form nine categories: (a) low-intensity vegetable garden, (b) low-intensity flower garden, (c) low-intensity combination garden, (d) medium-intensity vegetable garden, (e) medium-intensity flower garden, (f) medium-

intensity combination garden, (g) high-intensity vegetable garden, (h) high-intensity flower garden, and (i) high-intensity combination garden. These nine categories constituted the conceptual "types" of school gardens<sup>1</sup>.

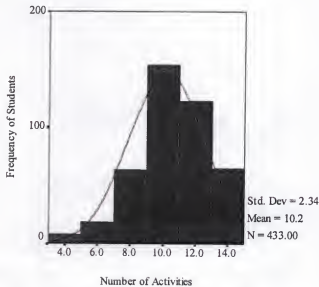
**Table 3-3. Possible factors to measure school garden intensity.**

Factor
<ol style="list-style-type: none"> <li>1. Average number of hours per week the students spend in the garden.</li> <li>2. Number and type of garden-related activities students participate in <i>prior</i> to gardening.</li> <li>3. Number and type of garden-related activities students participate in <i>while</i> in the garden.</li> <li>4. Percentage of time the teacher uses the garden as an instructional tool in the classroom.</li> <li>5. Number and type of subject areas into which the school garden program has been incorporated.</li> <li>6. Number of years the school garden has been a part of the teacher's curriculum.</li> <li>7. Type of group configuration that is used in the garden (individual, small groups, large groups).</li> <li>8. Approximate size of the garden.</li> <li>9. Forms of volunteer help used when gardening with students.</li> <li>10. Sources of information used to assist in the incorporation of school gardening into the curriculum.</li> <li>11. Types of educational material used in the classroom to support use of school gardening in the curriculum.</li> <li>12. How teacher and students utilize the end product of the garden.</li> <li>13. How students share the garden with others.</li> <li>14. Whether (and how) student teams/groups work on garden related assignments and activities.</li> <li>15. Number and type of science Sunshine State Standards that are addressed through the use of the school garden.</li> </ol>

<sup>1</sup>The typology for this study was based solely on the number of garden related activities students participated in prior to and while in the garden. Analyses were run with this single factor and with additional factors and it was found that nothing more was gained with the added factors. Correlation analyses of this factor and the other factors showed the factors to be significantly correlated (Table F-1, Appendix F). Therefore to keep the typology simple and elegant the best factor, number of activities was used. The procedure for construction of the typology is discussed on pg. 121.

**Table 3-4. Typology of school garden programs.**

<b>Garden Form</b>		<b>Intensity</b>		
		Low (0-8)	Medium (9-11)	High (12-14)
<b>Garden Form</b>	Vegetable garden	a) LV	d) MV	g) HV
	Flower garden	b) LF	e) MF	h) HF
	Combination garden	c) LC	f) MC	i) HC

**Figure 3-1. Distribution of number of activity scores.**

### **Procedure for Data Collection**

#### **Pilot Test**

A pilot test of the student survey was conducted at Metcalfe Elementary and at Terrwilliger Elementary in Gainesville, Florida on April 1 and 2, 2000, respectively to test instrument usability and student comprehension. Third-grade students participating in the pilot test were part of after-school programs at each school. The researcher met with students after school and was allowed to work with the students in a room away from the other after-school students. The researcher,

who was unknown to the students, established a rapport with the students by explaining that she was a university student who needed their help with a survey she had designed for students their age. The researcher discussed with students the meaning of a research project and how it involved asking questions and finding out information. She explained to the students that she needed their help to find out if students their age understood the questions on the survey.

According to LaGreca (1990), carefully worded instructions are a way to deal with students tending to give socially desirable answers. Before administering the survey, the researcher was sure to explain to the students that the survey was about them and their feelings and that there were no right or wrong answers. She was sure to emphasize that this was not a test, but rather a survey about them and the way they felt. She told the students that since the survey was about them, it was OK to have answers that were different from the other students taking the survey and that they were to choose the answer they most agreed with.

The researcher led students through the demographic questions on the survey before moving on to the example question. Initially, it was planned to read the entire survey out loud to the students to facilitate reading comprehension. However, at the first school participating in the pilot test, students read ahead and answered at their own pace despite instructions to the contrary. Once it was apparent that many of the students were reading ahead and students were on different questions at different times, the researcher conceded and allowed students to finish on their own and asked students to raise their hand if they reached a question they did not understand. Notes were taken on the questions or words that students did not understand. Once all the

students were finished with the surveys, the researcher asked the students to point out any questions or words they found confusing or did not understand or know and noted these questions and words. The total survey took approximately 30 minutes to administer.

### **Student Survey**

The Institutional Review Board at the University of Florida requires that when research involves students, consent from the student's parent must be obtained. Therefore, parental consent letters (Appendix C) were sent to the participating teachers two weeks prior to sending out the student surveys. Teachers were asked to send home the parental consent letters for parents to sign. Parents were provided with a copy of the consent letter for their records. Student surveys were sent to the participating schools the week of April 1, 2000. The third-grade teachers administered the student surveys as their schedules permitted. Teachers were asked to return the surveys by April 17, 2000. All teachers, with the exception of one, completed and returned their surveys during this two-week period. One teacher failed to receive the surveys when they were first sent, therefore a second set of surveys was sent the week of April 23, 2000. These surveys were returned by May 10, 2000.

Included with the student surveys were instructions for the teacher on how to administer the survey (Appendix D). In addition to instructions, a student assent script was included for the teacher to read to the students to gain their assent to take the survey. Teachers were also provided with a list of questions that gave students problems during the pilot test and examples on how to explain the question and/or answer (Appendix E). Upon completion of the teacher and student surveys, teachers

were asked to return the surveys to the researcher. In the event that not all of the teacher's students gained parental consent to take the student survey, it was recommended to teachers that they allow all their students to take the survey, but only return to the researcher those student surveys who had parental consent. Based on the number of students teachers reported having in their classes and the number of student surveys returned, a response rate of 54% was obtained.

### **Teacher Survey**

Teacher surveys were sent to participating teachers along with the student surveys during the week of April 1, 2000. Teachers were asked to return their completed surveys along with the student surveys by April 17, 2000. All teachers, with the exception of one returned the surveys by this specified date. The remaining teacher returned the surveys by May 10, 2000. Prepaid postage envelopes were provided so that the teacher would not incur any costs for participation. All the teachers asked to participate in the study returned the teacher surveys, this accounts for a 100% response rate among participants.

### **Statistical Procedures**

Initially, descriptive statistics (frequency, mean, standard deviation, range) of participant characteristics and all measures were computed. Procedures were then taken to determine the intensity of a school garden program. To accomplish this task, several typologies were constructed to ascertain which typology best measured school garden intensity. Once constructed, one-way analysis of variance (ANOVA) tests were run to identify the best typology of school garden intensity. After a typology

was identified, correlation analysis was used to determine whether the typology chosen was correlated with the other possible typologies, thus ensuring that the typology chosen was effective in explaining school garden intensity and type.

Results of correlation analyses are reported in Table F-1, Appendix F.

Once the suitable typology was found, ANCOVA tests were run to determine if there were significant differences in regard to garden intensities and types, and the dependent variables of youth developmental assets - responsibility, students' attitudes toward science, students' attitudes toward the environment, and students' attitudes toward the garden. Analysis of covariance is a statistical procedure that employs the use of a preexisting variable that is correlated with the dependent variables, the covariate, to improve the precision of the analysis. ANCOVA removes the portion of the dependent-variable score variance that is associated with the covariate variance, thus allowing the difference due to the independent variable to be more clear (Ary, Jacobs, & Razavich, 1996). The covariate used in the subsequent analyses was the number of years the school garden had been a part of the curriculum. It was hypothesized that the number of years the garden had been a part of the curriculum could affect the intensity of the garden experience as well as students' asset development and attitudes toward science, the environment, and the garden. All analyses were run using the Statistical Package for the Social Sciences for Windows<sup>TM</sup> Release 9.0 (SPSS®, 1999).

## CHAPTER 4

### RESULTS AND ANALYSIS

The results of the data analyses will be presented in this chapter. The five research questions and related hypotheses will be addressed.

#### Research Question 1

- 1.1 How and to what degree are teachers using school gardens?
- 1.2 What factors contribute to the intensity of a school garden program?
- 1.3 Do school gardens vary in intensity and form?

From observations, personal interviews, and a Delphi Technique interview process, several factors were thought to contribute to school garden intensity (Table 3-4). The first factor examined was the number of hours-per-week students spent in the garden. Teachers were asked to “indicate the number of hours a week, on average, your students spend in the garden.” This was an open-ended question. Almost half of the teachers (42.9%) stated that their students spent, on average, one hour a week in the garden. A quarter of the teachers (25%) said their students spent 1.5 to 2 hours in the garden, while a smaller percentage (21.5%) of teachers said that their students spent 3 or more hours in the garden (Table 4-1).

Another possible measure of the intensity of a school garden program was the percentage of time the garden was used as an instructional tool in the classroom. Teachers were asked to “indicate the percentage of time that you use the garden as an

instructional tool in your classroom." This question was open-ended. One teacher used the garden as an instructional tool 100% of the time, while another used it only .5% of the time. A little over half of the teachers (53.7%) used the garden as an instructional tool 10% or less of the time (Table 4-2).

**Table 4-1. The number of hours a week, on average, students spend in the garden.**

Hours per week	n	Valid percent	Mean	SD	Min	Max
.75	1	3.6	2.36	2.73	.75	15.00
1.00	12	42.9				
1.50	1	3.6				
1.75	1	3.6				
2.00	5	17.9				
2.50	2	7.1				
3.00	1	3.6				
4.00	3	10.7				
5.00	1	3.6				
15.00	1	3.6				

N = 28

**Table 4-2. The percent of time the garden is used as an instructional tool in the classroom.**

Percent of time	n	Valid percent	Mean	SD	Min	Max
0.5	1	3.6	19.19	21.13	0.5	100.0
5.0	7	25.0				
7.0	1	3.6				
8.0	1	3.6				
10.0	5	17.9				
15.0	2	7.1				
20.0	3	10.7				
30.0	2	7.1				
33.0	1	3.6				
35.0	1	3.6				
50.0	2	7.1				
100.0	1	3.6				

N = 28

Related to the percent of time the garden was used as an instructional tool in the classroom, was the number and type of subject areas into which teachers incorporated the garden. Teachers were asked to "mark the subject area(s) into which you have incorporated school gardening." Ten subjects were listed and teachers could mark all that applied (Table 4-3). All of the teachers participating in this study used the garden to teach science. All but two of the teachers used the garden to teach math. Environmental education was used by about two-thirds (67.9%) of the teachers, while language arts and health and nutrition were subjects 64.3% of the teachers addressed with the aid of the garden. In almost all cases, teachers were using the garden to teach multiple subjects.

**Table 4-3. Subject areas into which teachers have incorporated school gardening.**

Subject area*	n	Valid percent	Mean	SD	Min	Max
Science	28	100.0	19.19	21.13	0.5	100.0
Math	26	92.9				
Environmental education	19	67.9				
Language arts	18	64.3				
Health/nutrition	18	64.3				
Ethics (responsibility and nurturing)	16	57.1				
Social studies	9	32.1				
History	6	21.4				
Music	6	21.4				
Physical education	4	14.3				

\*Note: teachers could mark more than one subject area.

N = 28

The number of years the school garden program had been a part of the teachers' curriculum was thought to be another indicator of the intensity of the garden. An open-ended question, "please indicate the number of years that school gardening has been part of your program curriculum" was asked. This was an open-ended question. Close to half (48.1%) of the gardens being used by participants had been a part of the curriculum for 1 to 3 years. Several gardens had been a part of the curriculum for 4 to 5 years (21.4%). Only eight of the gardens being used by teachers had been a part of the curriculum for 7 or more years (Table 4-4).

**Table 4-4. The number of years that school gardening had been a part of teachers' curriculum.**

Number of years	n	Valid percent	Mean	SD	Min	Max
1	4	14.3	4.74	3.46	1	15
2	4	14.3				
3	5	17.9				
4	3	10.7				
5	3	10.7				
7	1	3.6				
8	4	14.3				
10	2	7.1				
15	1	3.6				

N = 27

Group configuration in the garden was also examined as a possible indicator of intensity. Teachers were asked "what type of garden set-up(s) are used at your school?" Five choices were given: a class garden, small group gardens (2 to 5 students), large group gardens (6 to 10 students), individual student gardens, or topic gardens for all classes. Class gardens were used by 50% of the teachers. Other arrangements used by teachers were large group gardens (14.3%), small group

gardens (7.1%), and topic gardens for all students (7.1%). Several teachers indicated that they used more than one type of group configuration in the garden.

The size of a school garden was another component thought to contribute to the intensity of a garden program. Teachers were asked "what is the approximate size of your garden in square feet." The question was open-ended. Garden size varied greatly. One-third (33.5%) of the 21 teachers that answered the question had small ( $5\text{ft}^2 - 45\text{ft}^2$ ) gardens, one-third had medium-sized gardens ( $50\text{ft}^2 - 150\text{ft}^2$ ), and the final third of the teachers had large gardens ( $196\text{ft}^2 - 1800\text{ft}^2$ ). The mean garden size was  $266\text{ft}^2$  with a standard deviation of  $451\text{ft}^2$ . Gardens ranged in size from  $5\text{ft}^2$  to  $1800\text{ft}^2$ .

Teachers were also asked to "indicate which form(s) of volunteer help you have used when gardening with students at your school" to determine if this contributed to the intensity of a garden program. Nine choices were given and teachers were asked to check all forms they used (Table 4-5). The majority (82.1%) of teachers used parental volunteers to help with their school gardens. The next most common forms of volunteer help included agriculture education members (35.7%) and older students at their school (35.7%).

The sources of information teachers used to assist in the incorporation of the garden into their curriculum were also examined. A question asking teachers to "indicate the source(s) of information used to assist in the incorporation of school gardening into your school's curriculum" was posed. Nine answer choices were given and teachers could check all sources they used (Table 4-6). Almost all of the teachers relied on their personal knowledge (89.3%) or friends/volunteers (75.0%) for

information. Other sources of information came from the County Extension service (39.3%) and education journals/publications (39.3%).

**Table 4-5. Forms of volunteer help teachers use when gardening with students.**

Form of help*	n	Valid	Mean	SD	Min	Max
		Percent				
Parents	23	82.1	2.5	1.9	0	7
Agriculture education members	10	35.7				
Older students	10	35.7				
Master Gardeners	8	28.6				
Senior citizens	6	21.4				
High school students	5	17.9				
Garden club members	3	10.7				
4-H members	3	10.7				
University students	2	7.1				

\*Note: teachers could mark more than one form of volunteer help.

N = 28

In addition to the sources of information teachers used, were the types of educational materials teachers used to incorporate the garden into their curriculum. "Please indicate the types of educational material(s) used in the classroom to support the use of school gardening in the curriculum" was asked of the teachers. Eleven types of materials were listed and teachers could marked all that applied (Table 4-7). The most common type of educational material teachers used was library books (89.3%). Gardening magazines and catalogs were the next most common type of educational material used (64.3%). Personal books, textbooks, trade books, the

internet, and experiments were all used by approximately half (53.6%) of the teachers to support the use of the garden in their curriculum.

**Table 4-6. Sources of information teachers use to assist in the incorporation of school gardening into their curriculum.**

Source*	n	Valid	Mean	SD	Min	Max
		Percent				
Personal knowledge	25	89.3	2.7	1.6	0	6
Friends/volunteers	21	75.0				
Educational journals/ publications	11	39.3				
County extension service	11	39.3				
Teacher in-service training	10	35.7				
National Gardening Assoc. Newsletter	10	35.7				
4-H education materials	8	28.6				

\*Note: teachers could mark more than one source of information.

N = 28

How teachers and students used the end product of the garden was examined as a possible intensity factor. Teachers were asked to “mark how you and your students utilize the end product of your garden.” Six choices were available and teachers could mark all that applied (Table 4-8). Almost all teachers and their students (89.3%) observed the end product of the garden. More than half of teachers and students shared the end product of their garden. Eating the end product of their garden was also utilized by about half of the teachers and students.

**Table 4-7. Types of educational materials teachers use to support the use of school gardening in their curriculum.**

Source*	n	Valid	Mean	SD	Min	Max
		Percent				
Library books	25	89.3	5.7	3.2	0	11
Gardening magazines and catalogs	18	64.3				
Internet	17	60.7				
Text books	15	53.6				
Trade books	15	53.6				
Personal books	15	53.6				
Experiments	15	53.6				
Videos	14	50.0				
Newspapers	13	46.4				
Computer software	9	32.1				
Filmstrips	3	10.7				

\*Note: teachers could mark more than one type of material.

N = 28

**Table 4-8. How teachers and students utilized the end product of their garden.**

Activity*	n	Valid	Mean	SD	Min	Max
		Percent				
Observe	25	89.3	3.4	1.6	0	6
Share	18	64.3				
Eat	15	53.6				
Record	14	50.0				
Donate	12	42.9				
Display	11	39.3				

\*Note: teachers could mark more than one activity.

N = 28

An additional factor examined as a potential indicator of intensity was how students shared their garden with others. Teachers were asked to "please mark how your students share the garden with others." Three choices: share work/process, share knowledge, and share products were listed and teachers could mark all that applied. The majority of teachers (78.6%) indicated that their students shared their work and the process with others. Many teachers (71.4%) also marked that their students shared their knowledge of the garden with others, while a little over half of the teachers (57.1%) marked that their students shared the garden products with others. Of the three ways the garden could be shared, about half the teachers (46.4%) reported that their students shared the garden two ways.

Teachers were also asked "do you have student teams/groups that work on garden-related assignments/activities?" Teachers could answer "yes" or "no." If teachers answered "yes," they were asked to describe the team/group assignments/activities. A majority of the teachers (67.9%) indicated that students were put in teams or groups, however, very few described the types of assignments/activities on which the groups/teams worked.

Since students' science attitudes were examined in this study, another element examined for its role in contributing to the intensity of the garden program was the number and type of science Sunshine State Standards (educational standards set by the Florida Department of Education) that were addressed through the use of the school garden. The number of standards addressed through the use of the garden ranged from 7 to 46 out of 46 possible standards. One quarter of the teachers were using the garden to address 7 to 20 standards. A little over a third of the teachers

were using the garden to address 21-26 standards and almost half (42.9%) of the teachers were addressing 27 to 46 standards with the garden. The mean number of standards addressed with the garden was 27 with a standard deviation of 10. The most common standards addressed through the use of the garden were those related to the processes that shape the earth, the nature of science, processes of life, and how living things interact with their environment. Table 4-9 lists the standards most commonly addressed through the use of the garden.

The final factor examined as a way to explain the intensity of a school garden was the number and type of garden-related activities students participated in prior to and while in the garden. Teachers were given a list of fourteen garden-related activities and asked to “mark **all** the activities that your students participate in *prior to gardening* and *while in the garden*.” Teachers revealed that the most common activity students participated in prior to gardening was preparing the garden (92.9%). This was followed by planning the garden (75.0%) and choosing plants (67.9%). The activities students participated in the most, while in the garden, were observing, planting, weeding, and watering (Table 4-10). Since teachers reported that students often participated in more than one type of activity both prior to and while in the garden, a sum of the number of activities students participated in was taken. Table 4-11 reports the number of activities students participated in prior to and while in the garden. Almost one-third (28.6%) of the teachers indicated that their students participated in 3 to 8 activities. A little over a third (39.2%) of the teachers marked that their students participated in 9 to 11 activities, while 32.1% of the teachers revealed that their students participated in 12 to 14 activities.

**Table 4-9. Most common science sunshine state standards addressed through the use of the school garden.**

Sunshine State Standard*	n	%
<b>Nature of matter</b>		
✓ Uses a tool to observe and study minute details of objects.	20	71.4
✓ Determines the physical properties of matter using metric measurements that incorporate tools such as rulers, thermometers, balances.	19	67.9
<b>Energy</b>		
✓ Knows that some source of energy is needed for organisms to stay alive and grow.	27	96.4
✓ Know different forms of energy.	18	64.3
<b>Processes that shape the earth</b>		
✓ Understands the stages of the water cycle.	26	92.9
✓ Knows that reusing, recycling, reducing the use of natural resources improve and protect the quality of life.	26	92.9
✓ Knows that approximately 75% of the surface of the earth is covered by water.	19	67.9
✓ Understands the processes of weathering and erosion.	17	60.7
<b>Earth and space</b>		
✓ Knows ways natural resources are important.	19	67.9
✓ Knows that days and nights change in length throughout the year.	17	60.7
<b>Nature of science</b>		
✓ Makes predictions and inferences based on observations.	27	96.4
✓ Plans and investigates an experiment that defines a problem, proposes a solution, identifies variables, collects and organizes data, interprets data in tables, charts and graphs, analyzes information, makes predictions, presents and supports findings	20	71.4
✓ Uses charts and graphs to understand patterns of change.	20	71.4
✓ Knows that it is important to keep accurate records and descriptions to provide information and clues on causes of discrepancies in repeated experiments.	19	67.9
✓ Uses various kinds of instruments to collect and analyze information.	18	64.3
✓ Knows that to work collaboratively, all team members should be free to reach, explain, and justify their own individual conclusions.		
<b>Processes of life</b>		
✓ Understands similarities and differences among plants.	26	92.9
✓ Understands the various ways that animals depend on plants for survival.	24	85.7
✓ Understands that although plants and animals are different, they also share common characteristics.	23	82.1
<b>How living things interact with their environment</b>		
✓ Understands that energy is transferred to living organisms through the food they eat.	24	85.7
✓ Understands that plants and animals share and compete for limited resources such as oxygen, water, food, and space.	23	82.1
✓ Knows how organisms with similar needs in a climatic region compete with one another for resources such as food, water, oxygen, or space to survive in an environment.	20	71.4
✓ Understands that scientific information can be presented in several ways.	19	67.9

\*Note: teachers could mark more than one standard.

N = 28

**Table 4-10. Garden-related activities students participated in prior to and while in the garden.**

Activity*	n	Valid percent
<i>Prior to gardening</i>		
Preparing	26	92.9
Planning	21	75.0
Choosing plants	19	67.9
Designing	9	32.1
<i>While gardening</i>		
Observing	28	100.0
Planting	27	96.4
Weeding	26	92.9
Watering	25	89.3
Fertilizing	18	64.3
Harvesting	17	60.7
Experimenting	16	57.1
Recording	16	57.1
Sitting	14	50.0
Playing	7	25.0

\*Note: teachers could mark more than one activity.

N=28

**Table 4-11. The number of garden-related activities students participated in prior to and while in the garden.**

Number of Activities*	n	Valid Percent	Mean	SD	Min	Max
3	1	3.6	9.9	2.6	3	14
6	1	3.6				
7	2	7.1				
8	4	14.3				
9	6	21.4				
10	3	10.7				
11	2	7.1				
12	4	14.3				
13	2	7.1				
14	3	10.7				

\*Note: teachers could mark more than one activity.

N = 28

To determine which indicator best explained the intensity of school garden programs, a series of analysis of variance (ANOVA) tests were run with seven of the fifteen possible indicators of school garden intensity: (a) number of hours per week students spend in the garden, (b) number of activities students participate in prior to and while in the garden, (c) percent of time the garden is used as an instructional tool in the classroom, (d) number of subject areas into which the garden has been incorporated, (e) number of years the garden has been a part of the curriculum, (f) number of sources of information and types of educational materials used to support the garden in the curriculum, and (g) number of science Sunshine State Standards addressed through the use of the garden (Table G-1, Appendix G). These seven indicators were chosen because they provided the best data set with which to construct possible typologies.

Through a series of ANOVA analyses of these seven factors, the number of garden-related activities students participated in prior to and while in the garden best explained the variation in the dependent variables. Bronfenbrenner and Morris' (1998) ecological model of human development and the notion that activity must take place for development to occur and this activity must become increasingly complex supports this finding. Therefore, the number of garden-related activities was used to establish the intensity of school garden programs. The number of garden-related activities students participated in ranged from 3 to 14. Frequency statistics and percentiles for the number of activities students participated in were computed. The frequencies and percentiles showed that one-third of the students participated in 0 to 8 activities, one-third in 9 to 11 activities, and one-third in 12 to 14 activities (Table 4-

11). Following this reduction, intensity was therefore coded such that low intensity was equal to 0 to 8 activities, medium intensity was equal to 9 to 11 activities, and high intensity was equal to 12 to 14 activities.

The number of activities factor was combined with garden form (vegetable, flower, or combination vegetable/flower) to create a typology of school garden types. This combination resulted in a nine-category typology: (a) low-intensity flower garden, (b) low-intensity flower garden, (c) low-intensity combination garden, (d) medium-intensity vegetable garden, (e) medium-intensity flower garden, (f) medium-intensity combination garden, (g) high-intensity vegetable garden, (h) high-intensity flower garden, and (i) high-intensity combination garden signifying a variation among school gardens by form and intensity (Table 3-3). This typology served as the main independent variable for data analysis.

The dependent variable scores of responsibility, science attitudes, environmental attitudes, and garden attitudes were placed within this nine-cell matrix and a series of analysis of covariance (ANCOVA) tests were run to determine if there were significant differences among the cells of the typology.

Table 4-12 shows the number and percentage of classes and students in each of the garden categories. Based on the typological categories it is evident that these school garden programs varied in intensity. An initial hypothesis of this study was that students in combination flower/vegetable gardens would have higher scores than students in vegetable and flower gardens, respectively. Additionally, it was also hypothesized that students in high intensity gardens would have higher scores than

medium and low intensity gardens, respectively. These hypotheses will be explored for each of the dependent variables.

**Table 4-12. Number and percentage of classes and students in the typology matrix.**

Garden Form			Intensity		
			Low	Medium	High
	Vegetable	Classes	1 (3.8%)	2 (7.7%)	1 (3.8%)
		Students	22 (5.2%)	23 (5.4%)	28 (6.6%)
	Flower	Classes	2 (7.7%)	5 (19.2%)	3 (11.5%)
		Students	28 (6.6%)	97 (22.7%)	80 (18.7%)
	Combination	Classes	4 (15.4%)	4 (15.4%)	4 (15.4%)
		Students	43 (10%)	43 (10%)	63 (14.8%)

Class N = 26

Student N = 427

Once the typology was established, the mean and standard deviation scores for each of the indicators thought to contribute to the intensity of school garden programs were computed for each type of garden (Table 4-13). Students in the medium intensity flower garden spent the most hours per week in the garden. However, the high intensity combination garden had the highest mean scores for every other factor: number of activities students participated in, percent of time the garden was used as an instructional tool, number of subject areas into which the garden had been incorporated, number of years the garden had been a part of the curriculum, number of sources and types of information/educational material used to incorporate the garden into the curriculum, and the number of science Sunshine State Standards the garden addressed. Inspection of only the mean scores for each of these factors would

indicate that no real trend is evident. The typology, in this case, sorts the data as expected, but low N in some cells generates responses that are within range of an increasing trend.

### Research Question 2

- 2.1 Do students using school gardens possess the youth developmental assets of achievement motivation, school engagement, responsibility, and interpersonal competence?
- 2.2 Do students possess the youth developmental assets of achievement motivation, school engagement, responsibility, and interpersonal competence in varying degrees depending on school garden type?

**Hypothesis:** There is a positive relationship between the number of youth developmental assets students possess and school garden type.

Initially, it was planned to determine whether school garden intensity contributed to students' development of four youth developmental assets: achievement motivation, school engagement, responsibility, and interpersonal competence. However, after factor analysis of the scales measuring each of these assets was conducted, the data indicated that only the scale measuring responsibility could be used reliably. Therefore, the student responses to the responsibility items were summed and the mean taken to provide a responsibility score. This mean responsibility score served as the dependent variable.

Table 4-13. Descriptive statistics of possible factors to measure school garden intensity based on garden type.

	TYPES*								
	1 LV	2 LF	3 LC	4 MV	5 MF	6 MC	7 HV	8 HF	9 HC
No. of hours per week students spend in the garden.	M=1.0 SD=0.0	1.2 1.8	1.2 0.6	1.5 0.7	4.8 5.9	1.9 0.8	1.0 0.0	3.0 1.7	1.9 1.4
Number of activities students participate in prior to and while in the garden	M=8.0 SD=0.0	5.5 3.5	7.3 1.0	9.5 0.7	9.2 0.4	10.3 1.0	12.0 0.0	12.0 0.0	13.5 0.6
Percent of time the garden is used as an instructional tool in the classroom.	M=5.0 SD=0.0	20.0 0.0	11.4 13.0	15.0 0.0	18.0 18.9	15.8 12.3	5.0 0.0	16.0 14.9	25.0 21.2
No. of subjects areas into which the garden has been incorporated.	M=6.0 SD=0.0	3.5 0.7	4.3 1.3	4.5 0.7	4.2 0.8	5.5 1.3	6.0 0.0	6.7 0.0	9.0 0.8
No. of years the garden has been a part of your curriculum.	M=2.0 SD=0.0	4.0 4.2	4.0 0.0	2.0 0.0	5.4 3.7	4.3 4.0	5.0 0.0	4.7 2.9	7.3 5.9
No. of sources and types of material used to support the garden in the curriculum.	M=10.0 SD=0.0	6.0 1.4	2.5 1.3	8.0 0.0	8.8 3.8	8.3 6.2	4.0 0.0	11.7 2.3	13.8 2.1
No. of Science Sunshine State Standards addressed through use of the garden.	M=26.0 SD=0.0	26.5 2.1	16.5 7.6	13.5 0.7	29.8 4.9	29.5 11.6	17.0 0.0	33.0 9.2	41.0 4.7

\* L = low intensity, M = medium intensity, H = high intensity, V = vegetable garden, F = flower garden, C = combination garden.

Table 4-14 shows that students' responsibility scores were all high and very little variation was found. The analysis of responsibility scores is summarized in Table 4-15. The model including typology, gender, ethnicity, and number of years the garden had been a part of the curriculum only explained 1.5% of the variation in responsibility scores. The typology alone explained .34% of the variation in the scores and was not statistically significant.

**Table 4-14. Typology of responsibility scores.<sup>1</sup>**

Garden Form		Intensity		
		Low	Medium	High
	Vegetable garden	4.42	4.61	4.29
	Flower garden	4.59	4.45	4.46
	Combination garden	4.42	4.33	4.57

$F = 1.448, p = .175$

<sup>1</sup>Scores ranged from 1 – (low) to 5 – (high)

### Research Question 3

- 3.1 In what ways do students' attitudes toward science differ depending on school garden type?
- 3.2 In what ways do students' attitudes toward science differ based on a variety of person and social context variables?

**Hypothesis:** There is a positive relationship between students' attitudes toward science and school garden type.

**Hypothesis:** Students' attitudes toward science do not differ by gender in the third grade.

**Table 4-15. Analysis of responsibility scores – main effects.**

<b>Dependent variable</b>	<b>Explained Variance</b>	<b>Cases</b>	<b>Grand Mean</b>	
Responsibility	.43%	427	4.46	
<b>Independent variable</b>	<b>Explained variance</b>	<b>Level of significance</b>	<b>Deviation from mean Unadjusted</b>	<b>Deviation from mean Adjusted</b>
Typology	.34%	.175		
1 LV			-.02	-.02
2 LF			+.12	+.12
3 LC			-.02	-.01
4 MV			+.19	+.21
5 MF			-.01	-.01
6 MC			-.13	-.14
7 HV			-.17	-.17
8 HF			.00	-.02
9 HC			+.11	+.10
Gender	>1%	.168		
Female			+.03	+.03
Male			-.04	-.04
Ethnic	>1%	.260		
White			+.01	+.02
Other			-.02	-.06
Number of years school gardening has been part of your curriculum	>1%	.836		

The third research question posed in this study was whether students' attitudes toward science varied based on garden types. Factor analysis of the data indicated that there were two measures for this variable: attitudes toward science and attitudes toward the usefulness of science. The responses for each of these measures were summed and the means taken separately to serve as the dependent variables of attitudes toward science and attitudes toward the usefulness of science study.

The ANCOVA analysis indicated that the differences among the science attitude scores when placed in the typology were statistically significant ( $F = 4.222, p = .000$ ). Inspection of the typology showed that students with the highest science attitude scores were in medium-intensity vegetable and combination gardens and low-intensity flower gardens (Table 4-16).

**Table 4-16. Typology of attitudes toward science scores.<sup>1</sup>**

Garden Form		Intensity		
		Low	Medium	High
	Vegetable garden	3.20	4.64	3.50
	Flower garden	4.24	3.88	4.12
	Combination garden	3.83	4.00	3.91

$F = 4.222, p = .000$

<sup>1</sup>Scores ranged from 1 – (low) to 5 – (high)

Table 4-17 summarizes the analysis for students' attitudes toward science scores. The model with the four independent factors explained 3.6% of the variation in students' scores. The typology of school garden intensity and form explained 3.5% of the variation in the scores and was statistically significant. The best predictor of students' attitudes toward science was therefore the type of garden in which students participate versus gender, ethnicity, and the number of years the garden had been a part of the curriculum.

Since the model was statistically significant, further analyses were run to explore if there were any interactions present in the model. The interaction of typology and gender was found to be significant. Table 4-18 shows the scores for female and male students within the respective typology cells. In all but two cases, medium-intensity combination garden and high-intensity flower garden, males had

higher attitude scores toward science than females. Female and male students in medium intensity vegetable gardens had the highest science attitude scores. Table 4-19 shows that the interaction of typology and gender significantly explained some of the variation in the model.

**Table 4-17. Analysis of science attitude scores – main effects.**

<b>Dependent variable</b>	<b>Explained Variance</b>	<b>Cases</b>	<b>Grand Mean</b>	
Attitudes toward science	3.6 %	427	3.94	
<b>Independent variable</b>	<b>Explained variance</b>	<b>Level of significance</b>	<b>Deviation from mean Unadjusted</b>	<b>Deviation from mean Adjusted</b>
Typology	3.5%	.000*		
1 LV			-.74	-.74
2 LF			+.30	+.28
3 LC			-.11	-.15
4 MV			+.70	+.62
5 MF			-.06	-.06
6 MC			+.06	+.07
7 HV			-.44	-.45
8 HF			+.18	+.20
9 HC			-.03	-.02
Gender	>1%	.787		
Female			-.02	-.01
Male			+.02	+.01
Ethnic	>1%	.401		
White			-.05	-.03
Other			-.13	+.08
Number of years school gardening has been part of your curriculum	>1%	.924		

\* $p < .001$

Table 4-18. Typology of attitudes toward science scores based on gender.<sup>1</sup>

Garden Form		Intensity		
		Low	Medium	High
	Vegetable garden	<i>F</i> 3.02 M 3.42	<i>F</i> 4.42 M 4.85	<i>F</i> 3.08 M 4.15
	Flower garden	<i>F</i> 4.21 M 4.27	<i>F</i> 3.85 M 3.91	<i>F</i> 4.37 M 3.82
	Combination garden	<i>F</i> 3.78 M 3.87	<i>F</i> 4.10 M 3.90	<i>F</i> 3.86 M 3.95

$F = 2.108, p = .034$

<sup>1</sup>Scores ranged from 1 – (low) to 5 – (high)

The second variable exploring science attitudes measured students' perceived usefulness of science study. The ANCOVA test indicated a significant difference among scores ( $F = 4.707, p = .000$ ). Inspection of the typology showed that the highest scores were from students in the medium-intensity vegetable garden. For the flower and combination gardens, those students in low-intensity gardens had the highest scores (Table 4-20).

Analysis of these scores is summarized in Table 4-21. The full model containing the typology, gender, ethnicity, and number of years the garden had been a part of the curriculum accounted for 3.0% of the variation in the scores. The typology explained 2.6% of the variation and was statistically significant. The best predictor of students' attitudes toward the usefulness of science study was the typology of garden intensity and form.

Table 4-19. Analysis of science attitude scores – interactions.

Dependent variable	Explained Variance	Cases	Grand Mean	
Attitudes toward science	3.6 %	427	3.94	
Independent variable	Explained variance	Level of significance	Deviation from mean Unadjusted	Deviation from mean Adjusted
Typology	3.5%	.000*		
1 LV			-.74	-.74
2 LF			+.30	+.28
3 LC			-.11	-.15
4 MV			+.70	+.62
5 MF			-.06	-.06
6 MC			+.06	+.07
7 HV			-.44	-.45
8 HF			+.18	+.20
9 HC			-.03	-.02
Gender	>1%	.785		
Female			-.02	-.01
Male			+.02	+.01
Ethnic	>1%	.397		
White			-.05	-.03
Other			-.13	+.08
Number of years school gardening has been part of your curriculum	>1%	.923		
Interaction typology*gender	1.7%	.034**		
Interaction typology*ethnic	.9%	.358		

\* $p < .001$  \*\* $p < .05$ 

Since the model was statistically significant, further analyses were run to test for interactions. As with attitudes toward science, an interaction of the typology and

gender was found to be statistically significant (Table 4-22). Both females ( $M = 4.56$ ) and males ( $M = 4.08$ ) in medium-intensity vegetable gardens had the highest scores for the usefulness of science study. Females and males participating in flower gardens had different scores based on the intensity of the garden. Females scored highest if they were in a high-intensity flower garden, compared with males who scored highest if they were in a low-intensity flower garden. Combination gardens produced the same scoring pattern with females and males.

**Table 4-20. Typology of attitudes toward the usefulness of science study scores.<sup>1</sup>**

Garden Form		Intensity		
		Low	Medium	High
	Vegetable garden	3.39	4.31	3.08
	Flower garden	3.96	3.84	3.82
	Combination garden	3.76	3.58	3.72

$F = 4.707, p = .000$

<sup>1</sup>Scores ranged from 1 – (low) to 5 – (high)

#### Research Question 4

- 4.1 In what ways do students' attitudes toward the environment differ depending on school garden type?
- 4.2 In what ways do students' attitudes toward the environment differ based on a variety of person and social context variables?

**Hypothesis:** There is a positive relationship between students' attitudes toward the environment and school garden type.

**Hypothesis:** Students' attitudes toward the environment do not differ by gender in the third grade.

**Table 4-21. Analysis of usefulness of science study attitude scores – main effects.**

Dependent variable	Explained Variance	Cases	Grand Mean	
Attitudes toward the usefulness of science study	3.0 %	427	3.75	
Independent variable	Explained variance	Level of significance	Deviation from mean Unadjusted	Deviation from mean Adjusted
Typology	2.6%	.000*		
1 LV			-.35	-.43
2 LF			+.22	+.19
3 LC			+.01	-.08
4 MV			+.57	+.33
5 MF			+.10	+.11
6 MC			-.16	-.13
7 HV			-.66	-.70
8 HF			+.07	+.13
9 HC			-.02	+.07
Gender	.2%	.121		
Female			+.06	+.06
Male			-.06	-.06
Ethnic	.2%	.085		
White			-.06	-.06
Other			+.17	+.16
Number of years school gardening has been part of your curriculum	.3%	.055		

\* $p < .001$ 

The fourth goal of this research study was to examine the environmental attitudes of students and whether they differed in relation to school garden intensity and form. Initial analysis of the environmental attitude scores is presented in Table 4-24 and shows that all scores are high and no significant differences among scores exists. The full model explains only .3% of the variation in environmental attitude

scores and was not statistically significant (Table 4-25). In fact, none of the independent factors significantly explained the variation in scores.

**Table 4-22. Typology of attitudes toward usefulness of science study scores<sup>1</sup> based on gender.**

Garden Form		Intensity		
		Low	Medium	High
	Vegetable garden	<i>F</i> 3.33 M 3.46	<i>F</i> 4.56 M 4.08	<i>F</i> 2.78 M 3.55
	Flower garden	<i>F</i> 3.92 M 4.02	<i>F</i> 3.83 M 3.85	<i>F</i> 4.01 M 3.60
	Combination garden	<i>F</i> 3.72 M 3.79	<i>F</i> 3.79 M 3.39	<i>F</i> 3.93 M 3.56

$F = 2.039, p = .041$

<sup>1</sup>Scores ranged from 1 – (low) to 5 – (high)

### Research Question 5

- 5.1 In what ways do students' attitudes toward school gardens differ depending on school garden type?

The final variable of interest in this study was how students' attitudes toward the garden varied with respect to garden intensity and form. Table 4-26 depicts the typology of garden attitudes. The highest garden attitude scores were from students in high-intensity flower and combination gardens and in the medium-intensity flower gardens. The difference among garden attitude scores was found to be statistically significant ( $F = 10.066, p = .000$ ). Analysis of the garden attitude scores showed that in addition to the typology, gender and ethnicity also significantly explained the variation in scores. The overall mean score for females was 4.29 and 4.02 for males.

The mean score for white students was 4.13, while non-white students had a mean score of 4.27.

**Table 4-23. Analysis of usefulness of science study attitude scores – interactions.**

Dependent variable	Explained Variance	Cases	Grand Mean	
Attitudes toward the usefulness of science study	5.3%	427	3.75	
Independent variable	Explained variance	Level of significance	Deviation from mean Unadjusted	Deviation from mean Adjusted
Typology	2.6%	.000*		
1 LV			-.35	-.43
2 LF			+.22	+.19
3 LC			+.01	-.08
4 MV			+.57	+.33
5 MF			+.10	+.11
6 MC			-.16	-.13
7 HV			-.66	-.70
8 HF			+.07	+.13
9 HC			-.02	+.07
Gender	.2%	.115		
Female			+.06	+.06
Male			-.06	-.06
Ethnic	.2%	.080		
White			-.06	-.06
Other			+.17	+.16
Number of years school gardening has been part of your curriculum	.3%	.051		
Interaction typology*gender	1.1%	.041**		
Interaction typology*ethnic	1.0%	.065		

\* $p < .001$  \*\* $p < .05$

Table 4-24. Typology of environmental attitudes.<sup>1</sup>

		Intensity		
		Low	Medium	High
<b>Garden Form</b>	Vegetable garden	4.83	4.72	4.68
	Flower garden	4.85	4.85	4.83
	Combination garden	4.88	4.67	4.77

$F = 1.518, p = .149$

<sup>1</sup>Scores ranged from 1 – (low) to 5 – (high)

Table 4-25. Analysis of environmental attitude scores – main effects.

Dependent variable	Explained Variance	Cases	Grand Mean	
Attitudes toward the environment	.3 %	427	4.80	
Independent variable	Explained variance	Level of significance	Deviation from mean Unadjusted	Deviation from mean Adjusted
Typology	.2%	.149		
1 LV			+.02	-.02
2 LF			+.05	+.05
3 LC			+.08	+.08
4 MV			-.08	-.09
5 MF			+.05	+.05
6 MC			-.13	-.14
7 HV			-.12	-.13
8 HF			+.03	+.03
9 HC			-.03	-.02
Gender	>1%	.242		
Female			+.02	+.02
Male			-.03	-.02
Ethnic	>1%	.144		
White			+.02	+.01
Other			-.05	-.04
Number of years school gardening has been part of your curriculum	>1%	.057		

**Table 4-26. Typology of attitudes toward the garden.<sup>1</sup>**

Garden Form		Intensity		
		Low	Medium	High
	Vegetable garden	3.81	4.48	2.80
	Flower garden	4.16	4.24	4.25
	Combination garden	4.07	4.28	4.57

$F = 10.066, p = .000$

<sup>1</sup>Scores ranged from 1 – (low) to 5 – (high)

Further analysis of garden attitude scores is reported in Table 4-27. The full model was successful in explaining 8.6% of the variation in garden attitude scores. The typology of garden types significantly explained 7.0% of the variation. Additionally, gender significantly explained 1.2% of the variation as did ethnicity, significantly explaining .4% of the variation. The typology variable, however was the best predictor of students' attitudes toward the garden versus the variables of gender, ethnicity, and number of years the garden had been a part of the curriculum.

Since the model was statistically significant, a further analysis was run to determine if there were any significant interactions present. Table 4-28 shows that the interactions were not statistically significant.

In summary, descriptive statistics showed that teachers were using school gardens in many different ways and to varying degrees. Typological construction using garden form and garden intensity produced a nine-cell matrix that served as the independent variable. ANCOVA analysis of the dependent variables of responsibility and student attitudes toward science, the usefulness of science study, the environment, and the garden were conducted to determine if there were significant differences among garden types. Significant differences were found among garden type and attitudes toward science, the usefulness of science, and garden attitudes. No

differences were found among garden type and students' sense of responsibility and their environmental attitudes. This was due to high scores for each garden type and little variation among these high scores.

**Table 4-27. Analysis of garden attitude scores – main effects.**

<b>Dependent variable</b>	<b>Explained Variance</b>	<b>Cases</b>	<b>Grand Mean</b>	
Attitudes toward the garden	8.6 %	427	4.17	
<b>Independent variable</b>	<b>Explained variance</b>	<b>Level of significance</b>	<b>Deviation from mean Unadjusted</b>	<b>Deviation from mean Adjusted</b>
Typology	7.0%	.000*		
1 LV			-.36	-.39
2 LF			-.02	-.06
3 LC			-.10	-.17
4 MV			+.31	+.10
5 MF			+.07	+.07
6 MC			+.12	-.17
7 HV			-1.37	-1.43
8 HF			+.08	+.14
9 HC			+.41	+.49
Gender	1.2%	.000*		
Female			+.13	+.16
Male			-.15	-.17
Ethnic	.4%	.043**		
White			-.04	-.07
Other			+.10	+.19
Number of years school gardening has been part of your curriculum	> 1%	.382		

\* $p < .001$  \*\* $p < .05$

Table 4-28. Analysis of garden attitude scores – interactions.

Dependent variable	Explained Variance	Cases	Grand Mean	
Attitudes toward the garden	10.4%	427	4.17	
Independent variable	Explained variance	Level of significance	Deviation from mean Unadjusted	Deviation from mean Adjusted
Typology	7.0%	.000*		
1 LV			-.36	-.39
2 LF			-.02	-.06
3 LC			-.10	-.17
4 MV			+.31	+.10
5 MF			+.07	+.07
6 MC			+.12	-.17
7 HV			-1.37	-1.43
8 HF			+.08	+.14
9 HC			+.41	+.49
Gender	1.2%	.000		
Female			+.13	+.16
Male			-.15	-.17
Ethnic	.4%	.042		
White			-.04	-.07
Other			+.10	+.19
Number of years school gardening has been part of your curriculum	>1%	.379		
Interaction typology*gender	1.2%	.085		
Interaction typology*ethnic	.7%	.424		

\* $p < .001$  \*\* $p < .05$

## CHAPTER 5 DISCUSSION

### Study Summary

Several youth development theories (cognitive, social cognitive, and ecological) provided the theoretical framework for a study of school gardens and their impact on youth. Current uses of school gardens by teachers were investigated. A teacher questionnaire was developed to gain insight into how teachers used school gardens with their students and in their curriculum. The information gathered from 28 third-grade teachers was used to develop a multi-level framework that incorporated school garden intensity based on the number of garden-related activities students participated in prior to and while in the garden and school garden form: flower, vegetable or combination flower/vegetable.

Elements of positive youth development: youth developmental assets (achievement motivation, school engagement, responsibility, and interpersonal competence) and attitudes toward science, the environment, and the garden of 427 third-grade students were examined. These elements were examined in relation to school garden intensity and form. Gender, ethnicity, and the number of years the garden had been a part of curriculum were other variables examined for their relationship to the positive youth development elements.

To investigate the elements of positive youth development, a student survey was created by combining several indices. Search Institute's *Profiles of Student Life*:

*Attitudes and Behaviors* (Scales & Leffert, 1997) for sixth- to twelfth-grade students was modified for use with elementary-age students to measure the youth developmental assets. The University of Iowa's *Attitudes, Preferences, and Understandings* (1988) index was used to measure students' attitudes toward science. Based on questions found in the *Attitudes, Preferences, and Understandings* index, five questions related to students' attitudes toward the garden were created. Two environmental attitude indices, the *Children's Environmental Response Inventory* (Bunting & Cousins, 1985) and Jaus' (1984) environmental attitude scale were combined to measure students' environmental attitudes.

Factor analysis of these indices revealed that for the youth developmental assets, only the scale measuring responsibility could be used reliably. Additionally, factor analysis revealed two scales measuring science attitudes: attitudes toward science and attitudes toward the usefulness of science that could be used reliably. Factor analysis also showed that only the questions dealing with caring for the environment could be used reliably. All questions measuring students' attitudes toward the garden could be used reliably.

Five research questions and hypotheses were investigated. Descriptive statistics were used to summarize how and to what degree teachers used school gardens. Examination of these statistics showed that teachers used school gardens differently and to varying degrees. This variation among gardens was simplified into a multi-level framework or typology of high, medium, and low intensity based on the number of garden-related activities students participated in prior to and while in the garden and the form of school gardens (flower, vegetable, or combination

flower/vegetable). This typology consisted of nine types of gardens: (1) low-intensity flower garden, (2) low-intensity flower garden, (3) low-intensity combination garden, (4) medium-intensity vegetable garden, (5) medium-intensity flower garden, (6) medium-intensity combination garden, (7) high-intensity vegetable garden, (8) high-intensity flower garden, and (9) high-intensity combination garden. Analysis of covariance were used to determine if there were significant differences among the nine types of school gardens. Significant differences were found among school garden types and students' attitudes toward science, attitudes toward the usefulness of science study, and garden attitudes. While there were no significant differences among school garden types and students' responsibility and environmental attitude scores, scores for each of these elements were very high (indicating a sense of responsibility and a positive environmental attitude) with little variation. Although the typology of school gardens significantly explained the variation in students' science attitude and garden attitude scores, it did not account for a large percentage of the variance in attitude scores.

### **Purposes of This Study**

An examination of how teachers are using school gardens was a primary focus of this study. Previous studies have examined school gardens and their impact on students, but all have done so within an experimental setting, that is studies have looked at the effects of a given school garden program and/or curriculum on students. To date, no research endeavor has explored how teachers use school gardens without the influence of a specified program and/or curriculum. Therefore, this study represented a beginning effort to describe how teachers use school gardens and what

affect these gardens have on the students participating in such garden programs.

Specifically, this study was designed to accomplish the following goals:

1. Determine how teachers use school gardens with their students and within their curriculum and if variation exists in the uses of school gardens.
2. Determine the factor(s) that contribute to the intensity of a school garden program.
3. Develop a multi-level framework that incorporates both school garden intensity and school garden form (flower, vegetable, or combination flower/vegetable) to explore elements of positive youth development: youth developmental assets (achievement motivation, school engagement, responsibility, and interpersonal competence) and students' attitudes toward science, the environment, and the school garden.
4. Adapt existing measures, or develop new measures, to enable the study of school gardens.
5. Provide theoretical and empirical support that will assist with the design and use of school gardens for elementary-age children.

This chapter discusses the results found as they related to these purposes. The specific research questions and hypotheses examined will be summarized. Implications for theory, research, and practice will also be considered. Limitations of the study will be discussed. Finally, there will be a discussion of the contributions of this study.

## Discussion of Findings

### Research Question 1

#### 1.1 How and to what degree are teachers using school gardens?

To determine how and to what degree teachers are using school gardens, teachers were asked to complete a questionnaire addressing several indicators thought to contribute to the intensity of a school garden program (Table 3-3). Teachers' responses to this questionnaire revealed that there were indeed varying degrees of garden use, both with students and in the curriculum.

About half of the teachers and their students used the garden only one hour a week (Table 4-1). The other half of the teachers and students used the garden from 2 to 15 hours a week. In addition to time spent in the garden, a little over half of the teachers surveyed only incorporated the garden into their curriculum 10% or less of the time (Table 4-2).

All teachers were using the garden to teach science (Table 4-3). Almost half of the teachers indicated that the garden helped address 26 to 46 (out of 46 possible) science Sunshine State Standards. Many of these standards address concepts cited by educators that could be met through the use of the garden: problem solving, observing and predicting skills, life cycles, habitats, weather, and plants (Gywnn, 1988; Nelson, 1988; Oehring, 1993; Stetson, 1991). This finding supports educators' assertion that gardens assist in academic learning.

A majority of the teachers were also using the garden to teach math (92.9%) and environmental education (67.9%, Table 4-3). Environmental education has been found to be a common subject addressed through the use of the garden (DeMarco,

1999; Sheffield, 1992; Skelly & Bradley, 2000). Teachers also were using the garden to help teach language arts (64.3%), health and nutrition (64.3%), ethics (responsibility and nurturing) (57.1%), social studies (32.1%), history (21.4%), music (21.4%), and physical education (14.3%, Table 4-3). These percentages indicate that Hemenway's (1903) argument that a garden can be used to teach practically every subject taught in the classroom is supported. The findings of Wotowiec (1975) that students and parents did not believe that the garden program being used by Cleveland Public Schools promoted practical application of academic skills and knowledge is sharply contrasted by this study's and others (DeMarco, 1999; Sheffield, 1992; Skelly & Bradley, 2000) that teachers are using a school garden to teach essentially every classroom subject.

Most gardens being used by teachers had been a part of their curriculum from 1 to 3 years (Table 4-4). Two-thirds of the gardens in use were 150ft<sup>2</sup> or less in size. The most common type of garden set-up used by teachers was a classroom garden. A few teachers were using large group (6-10 students) and small group (2-5 students) gardens. A majority of the teachers did indicate that they put their students in teams/groups to work on garden-related assignments/activities. When asked how their students utilized the end product of their garden, most reported that their students observed the end product. Sharing, eating, and recording were mentioned by over half of the teachers as ways of using the end product. Donating and displaying the end product were two other ways of utilizing the garden by a few teachers. Sharing and donating products of the garden with others is thought by several

educators (Barron, 1993; Canaris, 1995) to foster a sense of community connectedness.

DeMarco (1999) found that adequate volunteer help is one of the most important factors, cited by teachers, for a successful garden. The form of volunteer help used by almost all teachers in this study came from parents (Table 4-5). A few were using agriculture education members or older students at their school. Teachers in DeMarco's study also reported that parents and older students were the most accessible and engaged sources of volunteer help. A majority of teachers in this study were utilizing only two to three forms of help. Very few teachers received help from Master Gardeners, garden club members, senior citizens, members of 4-H, or high school and university students (Table 4-5).

Personal knowledge was cited by all but two teachers as the source of information for incorporating the garden into their curriculum (Table 4-6). This is congruent with DeMarco's (1999) finding that teachers' own gardening knowledge is an important factor affecting the success of the garden. Friends and volunteers were sources of information for three-quarters of the teachers in this study. A third of the teachers were getting information from the County Extension office and education journals/publications. Less than half of the teachers surveyed used teacher in-service training, 4-H education materials, or the National Gardening Association's Growlab/Growing ideas newsletter as sources of information. None of the teachers received information from Lifelab or Master Gardener Training.

In relation to the sources of information, teachers were asked about the types of educational materials they used to support the use of the garden in their

curriculum. Overwhelmingly, most used library books and/or garden magazines or catalogs (Table 4-7). Half of the teachers were using personal books, trade books, textbooks, experiments and/or videos as educational materials. A few used newspapers, computer software, and/or filmstrips.

These findings indicate that, while teachers are using gardens and incorporating them into their classrooms, most are doing so with few sources of information and very little help from others. This lack of information and help may be due to teachers' insufficient knowledge of where to find information and who or what groups to look to for help. A great deal of information exists for teachers wishing to use school gardens both at a local level (e.g. County extension office) as well as at a national level (e.g. National Gardening Association's Growing Ideas newsletter). Teachers may be unaware of these sources of information and therefore not using them. Alexander et al. (1995) and DeMarco (1999) reported that teachers found Master Gardeners to be extremely helpful both in horticultural/gardening knowledge, but also in helping to reduce the teacher to student ratio. However, few teachers in this study were using Master Gardeners to help in their gardens. Other organizations such as garden clubs and 4-H are also useful in helping teachers and students in their gardens, but are under utilized.

From this information gathered from teachers, it is very apparent that teachers using school gardens do so in very different ways. While there are common elements found among teachers using gardens, the practice is very diverse. One of the goals of this study was to ascertain if diversity existed and if so, how could such diversity be classified in a way that would allow for a comparison of garden benefits to students.

One method thought to aid in the classification of school gardens was to determine the intensity of a school garden program.

### 1.2 What factors contribute to the intensity of a school garden program?

All of the factors addressed in research question 1.1 were thought to be possible contributors to the intensity of a school garden program. Of these, only one was used to calculate the intensity of a school garden program, the number of garden-related activities students participated in prior to and while in the garden. This indicator of intensity was chosen for several reasons: (a) it was based in theory, that is, Bronfenbrenner's (1979) theory of the proximal processes of development stating that activity must take place for development to occur and this activity must take place over time and become increasingly more complex, and (b) analyses showed this factor to explain the most amount of variation in scores.

Activities students participated in before gardening included: preparing, planning, choosing plants, and designing the garden. Activities students participated in while in the garden included observing, planting, weeding, watering, fertilizing, harvesting, experimenting, recording, sitting, and playing. A total of fourteen activities were possible. Analysis of the data indicated three levels of intensity: low (0 to 8 activities), medium (9 to 11 activities), and high (12 to 14 activities).

### 1.3 Do school gardens vary in intensity and form?

School garden intensity as determined by the number of garden-related activities students participate in prior to and while in the garden was found to vary

among schools. Teachers were also asked to disclose the form of garden they and their students were using. The three forms being utilized by teachers were flower gardens, vegetable gardens, or a combination of flower and vegetable gardens. Garden intensity and form were combined to create a nine-cell typology that classified gardens by intensity and form. Each cell of the typology constituted a conceptual type of gardens: (a) low-intensity vegetable garden, (b) low-intensity flower garden, (c) low-intensity combination garden, (d) medium-intensity vegetable garden, (e) medium-intensity flower garden, (f) medium-intensity combination garden, (g) high-intensity vegetable garden, (h) high-intensity flower garden, and (i) high-intensity combination garden. Each of these types of gardens was represented by at least one class participating in this study, indicating a variation of school gardens by intensity and form. These nine types served as the basis of analysis for exploring the impact of school gardens on elements of positive youth development.

Once the typology had been constructed using the number of garden-related activities and garden form, the mean scores for all other possible indicators of intensity were examined for each of the garden types in the typology. Although intensity was based on the number of garden-related activities students participated in, high intensity combination gardens had the highest means for every other indicator except for the number of hours students spent in the garden. Students in medium intensity flower gardens spent the most hours in the garden. While it was thought that these factors might offer some explanation as to the differences in garden type and students' sense of responsibility and attitudes toward science, the environment, and the garden, no other trend was apparent.

## Research Question 2

- 2.1 Do students using school gardens possess the youth developmental assets of achievement motivation, school engagement, responsibility, and interpersonal competence?
- 2.2 Do students possess the youth developmental assets of achievement motivation, school engagement, responsibility, and interpersonal competence in varying degrees depending on school garden type?

**Hypothesis:** There is a positive relationship between the number of youth developmental assets students' possess and school garden type.

While this study intended to examine the youth developmental assets of achievement motivation, school engagement, responsibility, and interpersonal competence, due to measurement issues, only the asset of responsibility was examined. The mean responsibility score for each type of garden ranged from 4.33 to 4.61 (out of a high score of 5). These high scores indicate that all students, regardless of garden type, possessed the asset of responsibility. With scores ranging so high, very little variation existed and therefore no significant differences among garden types were found. The hypothesis that there is a positive relationship between the number of youth developmental assets (responsibility) students' possess and school garden type was rejected.

This finding that students in all types of gardens possess a sense of responsibility does concur with educators' contention that the garden gives students a sense of responsibility (Canaris, 1995; Gwynn, 1988, Montessori, 1912). This may be due to teachers using the garden to teach responsibility. Approximately half

(57.1%) of the teachers in this study were using the garden to help teach ethics – responsibility and nurturing. However, until a comparative study of gardening students and non-gardening students is conducted, it is cautioned against inferring that the school garden is the reason for students' high sense of responsibility.

Since the indices measuring achievement motivation, school engagement, and interpersonal competence were unreliable, it is unknown how gardens may have impacted these variables. Previous studies, however, have found no significant differences in self-esteem, attitudes toward school (Sheffield, 1992; Waliczek, 1997), and interpersonal relationships (Waliczek, 1997) of students in gardening programs versus non-gardening programs.

### **Research Question 3**

- 3.1 In what ways do students' attitudes toward science differ depending on school garden type?
- 3.2 In what ways do students' attitudes toward science differ based on a variety of person and social context variables?

**Hypothesis:** There is a positive relationship between students' attitudes toward science and school garden type.

**Hypothesis:** Students' attitudes toward science do not differ by gender in the third grade.

In a study carried out by Skelly and Bradley (2000), researchers found that most elementary teachers in Florida were using school gardens to teach science. Yager and McCormack (1989) posited that science education should begin with

applications and connections to the real world. Understanding how science relates to the real world helps students realize the need to study the processes and information that pertain to science. Additionally, several researchers contend that if students are to become interested in science and to continue taking more science courses, they must have positive attitudes toward science and these attitudes should be in place at an early age (Catsambis, 1995; Farenga & Joyce, 1997; Simpson & Oliver, 1990; Yager & McCormack, 1985; Yager & Yager, 1989). Farenga and Joyce (1997) suggest several ways science can be taught in a manner that stimulates interest and to promote positive science attitudes: teach out of the classroom, in an informal manner, and through hands-on and inquiry-based activities. Each of these methods of teaching science can, in theory, be achieved with school gardens. Therefore, the science attitudes of students participating in school gardens were examined.

Factor analysis of the data indicated two measures of science attitudes: attitudes toward science (science is fun, exciting, boring, likeable) and attitudes toward the usefulness of science study (learning, using, testing). Attitudes toward science were examined first. The ANCOVA analysis indicated that there were significant differences among students' attitudes toward science depending on the type of garden in which they participated. Students with the most positive attitudes toward science participated in medium intensity vegetable gardens. Students in low intensity flower gardens and medium intensity combination gardens also had positive attitudes toward science. Overall, students in all types of gardens had positive attitudes toward science. Yager and Yager's (1985) study showing that more than half the third grade students in their study reported their science classes as exciting,

fun, and interesting supports this finding. No discernable trend was present in relation to the type of school gardens students participated in and their attitudes toward science.

With regard to how students' science attitudes differed based on their gender and ethnicity, the type of garden students participated in was the best predictor of their attitudes. Alone, gender and ethnicity did not significantly explain the variation in attitude scores. Further analysis of the data did, however, indicate a significant interaction between garden type and gender. Males in all but two of the garden types had higher science attitude scores than females. This is consistent with research findings that males typically have more positive science attitudes than females (American Association of University Women [AAUW], 1992; Farenga & Joyce, 1998; Linn & Hyde, 1989; Oakes, 1990). Females with the most positive attitudes toward science participated in medium intensity vegetable gardens, high and low intensity flower gardens, and medium intensity combination gardens. Again, no noticeable trend was present concerning the variables of garden type and gender as they pertain to science attitudes.

The second measure of science attitudes investigated students' attitudes toward the usefulness of science study. The analysis of covariance tests showed a significant difference among the types of school gardens and students' attitudes. Once again, students in the medium-intensity vegetable garden had the most positive attitudes toward the usefulness of science study. Students in low- and medium-intensity had the next highest scores measuring attitude. There was no apparent trend in students' attitudes and garden type. One interesting finding, however, was that, in

general, students' attitudes toward the usefulness of science study were less positive than their attitudes toward science. Yager and Yager (1985) suggest that the school imparts the perception of the usefulness of science study. Perhaps, teachers are imparting this perception to students in varying degrees, thus accounting for the lower scores of this attitude measure.

The person variables of gender and ethnicity were not significant in explaining the variation among usefulness scores, however the interaction between garden type and gender was again significant. Scores for this measure were not as divergent for male and females as they were with students' attitudes toward science. Females and males in medium intensity vegetable gardens had the most positive attitudes toward the usefulness of science study. One interesting trend observed was that females in high intensity flower and combination gardens had the most positive attitudes, while males in low intensity flower and combination garden had the most positive attitudes. No other trend was observed with regard to garden type and typology.

The hypothesis that there is a positive relationship among students' attitudes toward science and the usefulness of science study and school garden type was rejected as this trend was not observed. The hypothesis that students' attitudes toward science and usefulness of science study differ based on a variety of person and social context variables were accepted since differences in gender were observed. A plausible reason for the significant differences in science attitude scores and garden type is that, according to Simpson and Oliver (1980), the school, and more specifically, the classroom, has the strongest influence on students' attitudes toward

science. Teaching styles, classroom activities, and school/class environment may all contribute to these differences among garden types. Additional information about the school and classroom is needed to further explain the observed variation. While there was significant variation among students' attitudes toward science and the usefulness of science study and the type of garden in which they participated, it should be noted that students in all types of gardens had relatively positive attitudes toward science and its study. Positive science attitudes play a crucial role in determining whether students pursue future courses and interests in science. Simpson and Oliver (1980) found that if students enter middle or intermediate school with positive attitudes toward science they are more likely to continue taking science courses and be successful in these courses. School gardens can be places where science is made fun and interesting. School gardens are also places where inquiry-based learning can take place, learning is achieved through in an informal manner, and where science can be taught outside of the classroom. These are all suggestions for ways to teach science so that it stimulates interest and promotes positive science attitudes (Farenga & Joyce, 1997).

#### **Research Question 4**

- 4.1 In what ways do students' attitudes toward the environment differ depending on school garden type?
- 4.2 In what ways do students' attitudes toward the environment differ based on a variety of person and social context variables?

**Hypothesis:** There is a positive relationship between students' attitudes toward the environment and school garden type.

**Hypothesis:** Students' attitudes toward the environment do not differ by gender in the third grade.

The environmental attitude questions that were found to be reliable measured students' attitudes toward caring for the environment and recycling. The ANCOVA analysis revealed no significant differences among garden type and students' attitudes toward the environment. The reason for this finding is that students' attitudes were all very positive regarding the environment. Students' mean scores in all garden types ranged from 4.67 to 4.88 (out of a high score of 5), showing very little variation in scores. This finding is consistent with previous studies, which showed that school gardens can promote positive environmental attitudes in students that participate in the gardens (Skelly, 1997; Waliczek, 1997). The ability of school gardens to promote positive environmental attitudes in students may be due to the fact that a large majority of the teachers (67.9%) used their gardens to teach environmental education. Research has found that environmental education programs promote positive environmental attitudes in students (Bradley et al., 1997; Bryant & Hungerford, 1977; Dresner & Gill, 1994; Jaus, 1982, 1984; Ramsey & Rickson, 1976). Jaus (1984) found that programs with only two hours of instruction were effective in developing positive environmental attitudes in third grade students.

Since there were no significant differences found among the type of garden students participated in and their environmental attitudes, the hypothesis that there is a positive relationship among students' attitudes toward the environment and school garden type was rejected. On the other hand, the hypothesis that students' attitudes toward the environment do not differ by gender in the third grade was accepted.

Although there were no significant differences in students' environmental attitudes and garden type, the finding that all students had positive attitudes supports educators' claims that school gardens are ideal places to teach and foster environmental awareness (Canaris, 1995; Chawla, 1994; Gwynn, 1988; Pivnick, 1994; Stetson, 1991).

### **Research Question 5**

- 5.1 In what ways do students' attitudes toward school gardens differ depending on school garden type?

Another goal of this research study was to find out how students participating in school gardens felt about school gardens. Student responses to five questions measuring students' attitudes toward the garden (whether students the garden helped them learn new things, made them want to learn more, made learning fun, as well as being fun and exciting) were examined. Analysis indicated that students' attitudes did differ significantly depending on garden type. Scores ranged from 2.80 to 4.57 (out of a high score of 5). Students with the most positive garden attitudes participated in high-intensity flower and combination gardens, as well as medium-intensity vegetable gardens. The lowest attitudes toward the garden were for students participating in high-intensity vegetable gardens. It should be noted, however, that students in the high-intensity vegetable garden were from one class and their particular garden experiences may have negatively influenced their garden attitudes. Based on the observed trend that as intensity increased, students' garden attitudes increased (became more positive), it is unlikely that this one class is representative of the high-intensity vegetable garden experience. This trend indicates that the number

of garden-related activities students participated in prior to and while in the garden positively influenced their attitudes toward the garden.

Educators as well as researchers have cited enjoyment of the garden as an outcome of school gardening programs. How much students enjoy the garden is usually one of the first benefits mentioned by educators (Canaris, 1995; Gwynn, 1988; Stetson, 1991). Other benefits discussed by teachers are how the garden makes learning fun (Stetson, 1991) and exciting (Gwynn, 1988). Inspection of student responses to the garden attitude questions reveals that these benefits are tangible. Almost all of the students (83%) felt working in the garden was fun always or most of the time. Approximately three-quarters of the students reported that working in the garden was exciting (77.5%) and that the garden made learning fun (76.9%). Researchers (Barker, 1992; Kononshima, 1995) have also found that students in their studies liked and enjoyed working in the garden.

Analysis of the data also showed that gender significantly explained the variation in garden attitude scores. Females had significantly higher scores than males, indicating that females' attitudes toward the garden were more positive. Ethnicity also significantly explained variation in students' attitudes toward the garden. Non-white students scored higher than white students, suggesting that non-white students had a more positive attitude toward the garden. The interactions among garden type and gender and garden type and ethnicity did not significantly explain the variation in scores.

In summary, examination of the teacher data shows that teachers were using gardens differently and to varying degrees. These differences were found among gardens at different schools, but also among gardens at the same school. Investigation of student data showed that students in all types of gardens had high responsibility scores, indicating that students in all types of gardens possessed the youth developmental asset of responsibility. Similarly, students' environmental attitudes were all high, indicating that students in all types of gardens had positive environmental attitudes. Significant differences were found among garden type and students' attitudes toward science, their attitudes toward the usefulness of science, and their attitudes toward the garden. In general, while there were significant differences among garden type and these attitudes, most students' attitudes were positive. These findings indicate that variation among school gardens do exist and need to be identified before comparative studies of garden programs and non-garden programs commenced.

Although trends indicating that students' sense of responsibility and attitudes toward science, the environment, and the garden differed due to garden type were absent, several significant differences among garden types and attitudes were observed. This study was founded in the predominant theories of cognitive, social cognitive, and ecological development. The key concepts of these theories call for an examination of the school garden as a place for social interaction, as an environment, and as a microsystem environment where development may occur. To explore the garden in these ways, numerous questions were asked about the garden and its place in classroom curriculum. Teachers in this study reported that the garden was indeed a

place for social interaction among the students, their teachers, peers, parents and other adults. Additionally, teachers revealed that the garden was an environment in which students learned, interacted with others, and had and shared hands-on experiences. The *processes* that occur within this environment are important according to ecological theory (Bronfenbrenner & Morris, 1998). Proximal processes are necessary for development to occur. Analyses of the data collected from teachers and students showed that these necessary components of development varied along with school garden type. However, classroom data as it pertained to the garden experience was all that was collected and therefore it is impossible to know what other factors may have contributed to the observed differences. Additional information about classroom practices, teaching styles, and other outside influences is needed to more fully understand the influence *of the garden* on students.

### **Limitations of the Study**

The limitations of this study deal with the participant group. The group of teachers and students that participated in this study was purposively selected. Only teachers participating in the Florida School Garden Competition or Project SOAR were asked to participate. Therefore, the results of this study can only be generalized to these teachers and students and not to teachers and students throughout the world. Additionally, the analyses of this study were limited by the small number of teachers participating ( $N=28$ ). Although 448 students participated, the true  $N$  for this study was the number of teachers, or more specifically the number of classes composing each type of garden. In some cases, a few types of gardens were represented by only

one class of students, therefore not providing a true representation of that garden type. More classes using school gardens need to be studied so that the results become more generalizable. The measurement tools used also limited this study. Only one of the four assets under investigation was examined due to an inadequate index. Additionally, the index measuring environmental attitudes was limiting in regards to the type of environmental attitudes measured. Additional information was needed regarding educators' teaching styles, classroom practices, and attitudes to determine the role of the garden on the dependent variables. Regardless of the limitations, this study was exploratory and provided some important results. To date, this study is the only study that examines a school garden within the theoretical framework of cognitive, social cognitive, and ecological development theories.

### **Implications**

Three types of implications of this study are discussed in the following section: (a) implications for theory, (b) implications for future research, and (c) implications for practice.

#### **Implications for Theory**

This research began with the idea that the cognitive theory of Piaget (Good & Brophy, 1995; Meece, 1997; Woolfork, 1998), the social cognitive theories of Vygotsky (Gage & Berliner, 1988; Meece, 1997; Woolfork, 1998) and Bandura, (Bandura, 1986; Woolfork, 1986) and the ecological theory of human development (Bronfenbrenner, 1979, 1988, 1993; Bronfenbrenner & Morris, 1998; Garbarino,

1982) were compatible. A combination of these theories provided the framework for examining elements of positive youth development in the context of a school garden program. A review of these theories, their key concepts, limitations, and compatibilities was presented in Chapter 1.

### **Implications related to cognitive theory**

This study revealed that teachers are indeed using the garden as an instructional tool in their classroom. Many of them are using the garden in ways that are based on constructivist, discovery, inquiry, and problem-solving teaching practices. These teaching methods are derived from Piaget's theory of cognitive development. Piaget contended that children cannot simply have information and knowledge transmitted to them; they must act on the information and manipulate it so that it makes sense to them (Meece, 1997). To allow for this active involvement, the National Association for the Education of Young Children (NAEYC) has prescribed guidelines calling for classrooms that "allow for problem solving, hands-on experimentation, concept development, logical reasoning, and authentic learning" (Meece, 1997, p. 117). Teachers, in this study, were using their gardens to teach a wide variety of subjects and address many of the science state standards. Inspection of the standards being addressed with the garden shows that teachers were using the garden in ways called for by the NAEYC.

### **Implications related to sociocultural theory and social cognitive theory**

Vygotsky sociocultural theory and Bandura's theory of social cognitive development proved useful when developing the theoretical framework for this study.

The classroom, and more specifically, the garden are environments in which students interact with one another, their teacher, older students, parents, and other adults. According to social cognitive theory, these interactions play a central role in the development of children. Vygotsky's theory states that development occurs when children work collaboratively to solve problems. Analysis of the teacher data showed that the majority of teachers (67.9%) put their students in groups or teams to work on garden-related assignments. Additionally, interactions with adults can lead to scaffolding – leading children into more complex levels of thinking. Almost all of the teachers in this study (82.1%) had parents helping in the garden. Children's interactions with these adults could have influence on their development.

As with Vygotsky's theory, Bandura believes that cognitive skills and structures are derived through social interactions. Bandura's theory of social cognitive development theory reasons that the interactions of students' behavior, personal factors, and their environment influence their development. These interactions are reasoned to be the basis for learning by observation, or vicarious learning (Bandura, 1986). By watching other students or adults, students must focus their attention, construct images, remember, analyze, and make decisions (Woolfork, 1998). A garden is a place where students may observe their peers, teacher, or adults that help in their garden.

### **Implications related to ecological theory**

The finding that variation existed among users of school gardens can be linked back to Bronfenbrenner's ecological model of human development (Figure 1-2). According to this model, the school is a microsystem environment that has significant

impact on a child's development. The classroom environment, where a student spends approximately eight hours a day, and the garden as an element of that environment influence students' development because this system requires the students' first-hand participation and interaction.

The garden as an extension of the classroom environment can provide the settings for the activities required for development. The intensity of a school garden was based on the number of activities students participate in prior to and while in the garden. If these activities occur, take place on a regular basis over an extended period of time, become increasingly more complex, and require a degree of reciprocity, then development will occur. Based on teacher data, it is evident that activity in the garden was occurring, albeit at varying degrees. Additionally, analysis showed that the number of activities students participated in best explained the variation in students' attitudes toward science and usefulness of science scores, as well as their garden attitude scores. This demonstrates the usefulness of ecological theory for conceptualizing research theory and design.

### **Implications for experiential learning theory**

Teachers in previous studies have indicated that they use school gardens to promote experiential learning (DeMarco, 1999; Skelly & Bradley, 2000). This is most likely due to the ability of a garden to lend itself to experiences that can be drawn, articulated, and acted on. Stone (1994) states that these types of experiences allow development to occur.

Although teachers use the garden for experiential learning, because of the age group that participated and their level of cognitive development, most students will

experience stages 1 and 2 of Kolb's (1984) experiential learning model: (1) concrete and direct experience and (2) reflection and observation. The typological analysis indicates that all students are given the opportunity to reach stage 1, although at varying degrees, however it is unknown how many of the students reach stage 2. Teachers are providing the environment for experiential learning to take place by providing students with direct and concrete experiences that puts the subject matter being taught in a "real-world" context. As was mentioned previously, students enjoy working and learning in the garden and so this context is stimulating and interesting to students, two additional traits of a successful experiential learning experience (Osborne, 1994). Reaching stage 2 typically requires the teachers' guidance, and for this study, it was unknown if such guidance took place.

The conceptual foundation developed from these theories aided in the design of this study, strengthened the research, and aided in the understanding of research findings. The results of this research project based on this theoretical framework support the continued use of this theory combination in future research.

### **Implications for Future Research**

The findings of this study have several implications for future research. Methodological issues as well as recommendations for additional studies are addressed.

### **Methodological issues**

One of the primary goals of this study was to examine students' youth developmental assets and whether school gardens contributed to these assets. As of

yet, we do not have good reliable measures of some of the constructs, especially in regards to youth development. There are several factors that contribute to the difficulty in assessing youth development. Maturation is a problem that occurs during this time of rapid development. Additionally, children are influenced by many sources. We do know that the richness of the environment is important, however a one-time measure of this environment may not be adequate to assess the progressive complexity of environments.

Due to an inadequate measurement index, only one of the four assets under investigation was examined. The index used to measure these assets was developed for adolescent students in 6<sup>th</sup> to 12<sup>th</sup> grade, therefore statements and responses from the index had to be altered to so that they could be used with third-grade students. This change in wording could have caused the statements to lose their meaning and not measure the concept they were purported to measure. Factor analysis of the asset scales showed that the statements did not measure the assets they were designed to measure. A more appropriate tool needs to be developed so that these assets can be studied with younger students without altering existing instruments.

Similarly, an instrument measuring students' attitudes toward the environment needs to be developed. A commonly used instrument is the Children's Environmental Response Inventory (CERI, Bunting & Cousins, 1985), however it contains 185 statement, a number too high to be used in this study. For this reason, only a few questions were taken from the CERI. To accompany these questions were several that Jaus (1985) used successfully in a study with third-grade students. Factor analysis of this combined index indicated that only questions dealing with caring for

the environment could be used reliably. This limited what is known about students' environmental attitudes. While the CERI measures many dimensions of children's environmental attitudes and has an adequate reliability, a condensed version is needed if other variables besides environmental attitudes are to be examined in a study.

On the other hand, this study revealed the usefulness of the *Attitudes, Preferences, and Understandings* scale to measure student attitudes toward science as well as a scale to measure students' attitudes toward the garden. Questions comprising the science attitude scale produced an alpha reliability of .90, a mean of 3.96, and a standard deviation of 1.04. The usefulness of science study scale had an alpha of .65, a mean of 3.76, and a standard deviation of .87. Five questions to measure students' attitudes toward the garden were constructed based on questions measuring science attitudes. This new garden scale had an alpha reliability of .92, a mean of 4.19, and a standard deviation of 1.01. Due to the high reliability of each scale, especially the garden attitude scale, these could be used in future research studies.

### **Additional studies**

The first recommendation for additional studies is to replicate this study with similar and different groups of students. The qualitative and quantitative approach is also recommended as this combination provides more insight into the way a school garden is being used and how it may ultimately impact and benefit the students. Qualitative observational research of teachers using school gardens is suggested so that we learn more about the teaching styles, classroom environment, and teacher attitudes that may affect students' development.

A goal of this study was to determine if variation existed among the ways teachers and students used school gardens. To reach this goal, this study looked only at teachers using school gardens to gain an understanding of the within group variation. Now that it has been established that variation exists among users of school gardens, additional studies are recommended to study how school gardens benefit students in comparison with students not using school gardens. These studies need to occur with the knowledge that variation among school garden users exists and should be accounted for when comparing users to non-users. With this understanding in place, researchers can gain a better understanding of the extent to which a school garden may influence and benefit students using such gardens.

Another area for investigation includes looking at gardening programs as exemplary. Some school gardening programs may qualify as exemplary according to the National Science Teachers Association (see page 75 for a definition). In a study of exemplary science programs, Yager and Penick (1989) found that students perceived science as being fun, exciting, interesting, and less boring. Students in these programs also had more positive attitudes toward science and students' attitudes did not worsen over time (Simons & Yager, 1987; Yager, 1988, Yager & Penick, 1989). An examination of school gardens and school garden type as possible exemplary science programs is therefore warranted.

More studies examining school gardens, with students in many grade levels also need to occur. This study focused only on third graders whose sense of responsibility may already have been in place, and whose attitudes toward science, the environment, and the garden may already have been positive. Students' attitudes

toward science have been reported to start out high in elementary school but gradually decline as they progress up the grades (Ayers & Price, 1975; Yager & Penick, 1989). Studies with older and younger students may provide a better understanding as to the role of the garden in influencing asset and attitude development.

One variable not examined in this study due to logistical and design constraints was students' science achievement scores. Since all the teachers in this study were using the garden to teach science, an investigation into how the garden influences achievement scores is warranted. This type of study would be best carried out using a quasi-experimental design with students participating in a school garden and students not participating in a school garden. Such a study could reveal if the garden as a teaching tool for science is effective. One other way of carrying out this study would be to obtain state mandated achievement test scores for students in gardening and non-gardening programs to explore differences. Since teachers are using the garden to teach to different science standards, a standard test of science achievement would allow for such measurement.

Studies of school gardens should not be limited to science and environmental attitudes and knowledge gain. Future studies should explore all the potential benefits cited by educators using school gardens: development of skills such as sharing, teamwork, cooperation (In Virginia, 1992; Becker, 1995; Berghorn, 1988; Canaris, 1995; Gwynn, 1988; Neer, 1990), patience (Craig, 1997; Pivnick, 1994), self-control, self-esteem (Craig, 1997), self-confidence (Chawla, 1994; Dwight, 1992), self-reliance (Henry & DeLauro, 1996), leadership, organization, planning (Berghorn,

1988), responsibility (Canaris, 1995; Gwynn, 1988), discipline for being on time, following directions, making decisions (Dwight, 1992), a work ethic (Braun, 1989; Canaris, 1995; Dwight, 1992), a respect of work (Becker, 1995), positive feelings toward school, a desire to participate in school activities (Lucas, 1995; Stetson, 1991), and community connectedness (Barron, 1993; Canaris, 1995).

Each of these types of studies should also be carried out using pre- and posttest designs to obtain a measure of student variables before and after participating in a school garden program. Additionally, longitudinal studies of students who participate in school programs is needed to document possible long-term benefits. Longitudinal studies may also reveal if benefits derived from school gardening programs remain with the student or if they change over time.

In conclusion, this study and theories on which it was based provide a rationale for carrying out further related research. Efforts should continue to explore the impact and benefits school gardens have on and provide to students.

### **Implications for Practice**

The results of this study provide implications for practice by teachers using or wishing to use school gardens. Teachers should use school gardens to foster students' sense of responsibility. Students in all types of gardens had very high responsibility scores, indicating that they did indeed have a sense of responsibility. Teachers should allow students to participate in garden-related activities that advance this sense of responsibility. Some suggested activities include growing and nurturing a seed to a plant, watering plants, and tending to the garden as a whole.

School gardens should be used to assist in the teaching of science. The results of this study show that students participating in school gardens, in general, had positive attitudes toward science. Researchers claim that instilling positive attitudes toward science in children must start at a young age (Catsambis, 1995; Farenga & Joyce, 1998; Simpson & Oliver, 1990; Yager & McCormack, 1985; Yager & Yager, 1989). These researchers contend that possessing positive attitudes early on can improve students' interest in science and stimulate them to enroll in more science classes and even pursue a science-related career. School gardens provide a place where science can be taught informally and through hands-on and inquiry-based activities, two suggestions made by Farenga and Joyce (1998) as ways of stimulating interest in and promoting positive attitudes toward science. Programs that stimulate curiosity, creativity, and show connections to the real world have been shown to promote and perpetuate positive attitudes toward science (Yager & McCormack, 1989; Yager & Penick, 1989). School garden programs have the potential to accomplish these tasks.

Teachers should use school gardens to teach environmental education and encourage positive environmental attitudes. Knowledge of and positive attitudes toward the environment are necessary keys for making informed decisions about environmental issues (Ramsey & Rickson, 1976) and for carrying out environmentally responsible behavior (Ramsey et al., 1992). This study revealed that students in all types of gardens had positive attitudes toward the environment. School gardens give students a chance to interact with the environment and nature, which may influence their attitudes toward the environment positively. Additionally, school

gardens offer an ideal place to teach environmental education and to inform students about the environment and environmental issues.

Teachers should considering using combination flower and vegetable gardens with their students. While science attitude scores and responsibility scores were not significantly higher for students in combination gardens versus flower and vegetable gardens, students' attitudes toward the garden were highest for those student in high intensity combination gardens. Combination gardens offer the best of both types of gardens; they provide the aesthetics of a flower garden and the science of a vegetable garden. Many different types of lessons can be addressed through a combination garden ranging from art and language art lessons to math and science lessons. The diversity of a combination garden provides many benefits to teachers and students through education, but also through enjoyment. However, while a combination garden is recommended, the attributes of flower and vegetable gardens alone should not be overlooked. Students in medium intensity vegetable gardens had the highest science attitude and usefulness of science study attitude scores. Since most teachers are using vegetable gardens to teach science, their efforts seem to be effective in promoting positive science attitudes. For the purposes of this study, garden types were condensed into three types: flower, vegetable, and combination. Many teachers are using flower gardens to attract butterflies. Butterfly gardens are very popular among Florida elementary school teachers (Skelly & Bradley, 2000) and would fall under the flower category for this study. Butterfly gardens provide aesthetics, but also help teach science as it relates to butterflies and their life cycle. In conclusion,

all garden types are effective in their own ways, but to bring the best of all types together, a combination garden is recommended.

The initial phase of this research project was to determine how teachers are using school gardens. Results of this inquiry phase revealed that teacher in-service training and/or a school garden manual are needed. A training program and/or manual could provide teachers with many of the resources they seem to lack in regard to school gardens. One of the issues that could be covered in a training program or manual should be on volunteer help. Teachers do not appear to be getting the volunteer help they need in the garden or may be unaware of help that may be available to them. Most teachers were relying on help from parents and a few were getting help from agriculture education members or older students at their school. Very few teachers are using Master Gardener or garden club volunteers to help with their gardens. Efforts need to be taken to put teachers in touch with Master Gardener and garden club volunteers so that they may help teachers and students with their school gardens. These two groups of people are usually very knowledgeable about gardening and can assist teachers and students with problems they may be having in their gardens. Additionally, having more than one adult in the garden with students improves the student/teacher ratio, allowing all involved to gain a more from the garden experience.

Another topic to cover should be where teachers can get information that can help them design, use, and integrate a school garden into their curriculum. There are many sources of information available to teachers regarding gardening in general, school gardening, and environmental education. Teachers seem to be relying on their

own knowledge to incorporate gardening into their curriculum. While this is a worthwhile practice, utilizing other sources of information can only enhance the garden program. In addition to a resource of sources of information, the training and/or manual could provide teachers with a list of the numerous educational materials available to teachers using school gardens. These sources of information and educational materials can only help improve the way teachers use school gardens and subsequently improve the impact they have on students.

Ideally, an in-service training program along with a school garden manual would provide teachers with a plethora of information that will help them improve their school garden programs. While a manual may seem to suffice, a training program that brings in teachers from across the state or nation will allow for interaction and idea exchange among users of school gardens. This exchange of ideas can not only provide ideas on how to use the garden in the classroom and curriculum, but may also offer ways teachers can gain recognition and reward for their programs. DeMarco (1999) found that teachers in her study needed additional education to improve their use of school gardening. Teachers indicated that they were most interested in receiving this education through an in-service training course. Teachers felt the in-service education would best be gained by a training session with a school gardening expert, through Master Gardener training, or by taking continuing education or graduate courses at a local institution of higher learning. Most teachers wanted information about how to use the school garden as an effective teaching strategy as well as how to incorporate the garden into the curriculum and environmental education.

### **Contributions of this Study**

This study made several theoretical and practical contributions to the body of knowledge related to school garden research. First, this study was founded on the dominant theories of cognitive, social cognitive, and ecological development. Relationships of these theories to each other and to their role in examining school garden programs as a vehicle for youth development were presented. These developmental theories, along with experiential learning theory provided a strong theoretical base from which to design and conduct a study of the role of school gardens in positive youth development. These theories and their combination provide a sound means on which to design and carry out future studies.

This study was also the first to examine existing school gardens without using a curriculum or designed garden program as an experimental treatment. One objective of this study was to ascertain the effectiveness of school gardens as teachers are currently using them. A multi-level framework, or typology was constructed that allowed school gardens to be classified by their form (vegetable, flower, or combination vegetable/flower) and intensity, based on the number of activities students participated in prior to and while in the garden into nine types of school gardens. This allowed for ecological inquires such as by whom, for whom, how, and under what conditions school gardens were being used. This framework provided the basis for analyzing the dependent variables of responsibility and student attitudes toward science, the usefulness of science, the environment, and the garden. The typology successfully explained variation in students' science and garden attitude scores as they related to garden type. Even though only a small amount of the

variance was explained, when examined in the larger scheme of the number of influences on youth development, this finding is significant. This framework or typology would be useful in future studies of school gardens.

This study also marked the first time students' science attitudes were examined as they related to school gardens. Results from this study indicated that significant differences were present among different types of gardens. While no trend was evident as to which type of garden produced the most positive attitudes toward science, most students participating in this study had positive attitudes toward science and the usefulness of science study. Whether these attitudes are due to the garden program is unknown, but these findings provide a rationale for future studies.

Perhaps the most significant finding of this study is that as school garden intensity increased, students' attitudes toward the garden became more positive. Many educators and researchers have championed school gardens as places that allow children to have fun and enjoy themselves while learning. On a scale of 1 – (low) to 5 – (high), the mean garden attitude score for students in this study was 4.19 with a standard deviation of 1.01. This indicates that students were indeed enjoying the garden and that as they participated in more garden-related activities prior to and while in the garden, their attitudes toward the garden became more positive. This result is encouraging for teachers using school gardens as well as for teachers thinking of starting one.

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## APPENDIX A

## FLOWER SCALE USED IN STUDENT SURVEY



Always

Most of  
the timeHalf the  
time

Sometimes



Never

## APPENDIX B

## SCALE RELIABILITY AND CORRELATION STATISTICS

**Table B-1. The factor analysis and comprising variables for the youth developmental asset – responsibility scale**

Statement	Factor Score	Eigenvalue
I care how well I do in school.	.656	1.789
At school, I try as hard as I can to do my best work.	.656	
I accept responsibility for my actions when I make a mistake or get in trouble.	.642	
I do my best even when it is a job I do not like to do.	.628	

Explained variance = 45 Percent

**Table B-2. The correlation matrix of items in the youth developmental assets – responsibility scale.**

Variable	1	2	3	4
1. I accept responsibility for my actions when I make a mistake or get in trouble.	1.0			
2. I do my best even when it is a job I do not like to do.	.297*	1.0		
3. I care how well I do in school.	.195*	.246*	1.0	
4. At school, I try as hard as I can to do my best work.	.255*	.257*	.322*	1.0

\* = significant at  $p < .01$

**Table B-3. The factor analysis and comprising variables for the science attitudes scale**

Statement	Factor Score	Eigenvalue
I like science.	.874	3.537
Science time is fun.	.848	
Science time is exciting.	.800	
Science makes me want to learn more.	.758	
Science time is boring	.725	
Explained variance = 71 Percent		

**Table B-4. The correlation matrix of items in the science attitudes scale.**

Variable	1	2	3	4	5
1. Science time is fun.	1.0				
2. Science makes me want to learn more.	.659*	1.0			
3. I like science.	.739*	.645*	1.0		
4. Science time is exciting.	.677*	.631*	.727*	1.0	
5. Science time is boring.	.563*	.489*	.588*	.595*	1.0

\* = significant at  $p < .01$

**Table B-5. The factor analysis and comprising variables for the usefulness of science study scale.**

Statement	Factor Score	Eigenvalue
My teachers wants me to ask questions when we do science.	.682	2.296
Science time teaches me skill to use outside of school.	.581	
Being a scientist would be fun.	.577	
Science helps me test ideas I have.	.555	
Being a scientist that studies plants would be fun.	.505	
Explained variance = 46 Percent		

**Table B-6. The correlation matrix of items in the usefulness of science study scale.**

Variable	1	2	3	4	5
1. Science time helps me test ideas I have.	1.0				
2. Science time teaches me skills to use outside of school.	.437**	1.0			
3. My teacher wants me to ask questions when we do science.	.082	.080	1.0		
4. Being a scientist would be fun.	.431**	.350**	.108*	1.0	
5. Being a scientist that studies plants would be fun.	.477**	.399**	.008	.454**	1.0

\*\* = significant at  $p < .01$

\* = significant at  $p < .05$

**Table B-7. The factor analysis and comprising variables for the garden attitudes scale.**

Statement	Factor Score	Eigenvalue
The garden makes learning fun.	.900	3.822
Working in the garden is exciting.	.893	
Working in the garden makes me want to learn more.	.880	
The garden helps me learn new things.	.854	
Working in the garden is fun.	.844	
Explained variance = 76 Percent		

**Table B-8. The correlation matrix of items in the garden attitudes scale.**

Variable	1	2	3	4	5
1. Working in the garden is fun.	1.0				
2. Working in the garden makes me want to learn more.	.700*	1.0			
3. Working in the garden is exciting.	.715*	.719*	1.0		
4. The garden makes learning fun.	.667*	.726*	.773*	1.0	
5. The garden helps me learn new things.	.606*	.693*	.686*	.752*	1.0

\* = significant at  $p < .01$

**Table B-9. The factor analysis and comprising variables for the environmental attitudes scale.**

Statement	Factor Score	Eigenvalue
I think people must take care of the environment.	.725	1.894
I think people should try to recycle.	.704	
I think people should take care of plants and animals.	.681	
I think newspapers should be recycled.	.619	
Explained variance = 47 Percent		

**Table B-10. The correlation matrix of items in the environmental attitudes scale.**

Variable	1	2	3	4
1. I think people should take care of plants and animals.	1.0			
2. I think people should try to recycle.	.281*	1.0		
3. I think newspapers should be recycled.	.219*	.381*	1.0	
4. I think people must take care of the environment.	.315*	.323*	.309*	1.0

\* = significant at  $p < .01$

**APPENDIX C****SAMPLE PARENTAL CONSENT LETTER**

Dear Parent/Guardian,

I am a graduate student in the Department of Environmental Horticulture at the University of Florida, conducting research, under the supervision of Dr. Jennifer C. Bradley, on the possible benefits of school gardens to students. The purpose of this study is to examine the effect of school garden programs on the youth developmental assets of achievement motivation, school engagement, responsibility, interpersonal competence, attitudes towards science, and environmental attitudes of participating students. The results of the study may help determine if and how school garden programs are beneficial to students. These results may not directly help your child today, but may benefit future students.

Your child's teacher will give a survey, to students during the school day. The survey should take approximately 30 minutes to complete and will take place the first week of April. With your permission, your student will take the survey during this time. Students will be instructed to answer the survey questions, but they will not have to answer any question they do not wish to answer. The survey will be accessible only to the research team for verification purposes. Although the students will be asked to write their names on the questionnaires for matching purposes, their identity will be kept confidential to the extent provided by law. We will replace their names with code numbers. Results will only be reported in the form of group data. Participation or non-participation in this study will not affect the children's grades or placement in any programs. Any child without permission to participate will take the survey along with the other students, but the teacher will not return their survey to the researchers.

You and your child have the right to withdraw consent for your child's participation at any time without consequence. There are no known risks or immediate benefits to the participants. Students taking the survey will receive a packet of seeds as compensation for taking the survey. Group results of this study will be available in December upon request. If you have any questions about this research project, please contact me at (352) 392-7641 or my faculty advisor, Dr. Jennifer C. Bradley at (352) 392-7936. Questions or concerns about research participant's rights may be directed to the UFIRB office, University of Florida, Box 112250, Gainesville, FL 32611, (352) 392-0433.

Sonja Skelly

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I have read the procedure described above. I voluntarily give my consent for my child, \_\_\_\_\_, to participate in Sonja Skelly's study of school garden benefits to students. I have received a copy of this description.

---

Parent/Guardian

---

Date

---

2<sup>nd</sup> Parent/Witness

---

Date

**APPENDIX D**  
**SAMPLE TEACHER INSTRUCTIONS**

## STUDENT SURVEY INSTRUCTIONS

The survey should take approximately 30 minutes to administer.

1. Before passing out the student surveys, please read the following script to your students. This is to get assent from the students. Any student who doesn't raise their hand (not assenting to take the survey) does not have to take the survey.

"Students, today a graduate student, Sonja Skelly, from the University of Florida has asked us to take a survey. The survey will ask you some questions about you and how you feel about school and our school garden. There are no right or wrong answers to these questions. This survey is about you and how you feel, so your answers may be different from other students in your class. That's OK, you don't have to have the same answers. You can stop at any time. You do not have to answer any questions you don't want to. Your participation or non-participation will not affect your grades. If you want to take the survey raise your hand."

2. Pass out the student survey.
3. Have students write their name, your name, and their grade.
4. Have students write their birthday. This question presented some problems during the pilot test. We found that if we asked students to write their birthday, and gave them an example, such as April 16, 1990, they understood what to put down. Using birthdays is more accurate than asking students for their age.
5. Go over the example on the second page. The amount of petals on the flower is designed to give students a visual picture of the responses.

They can circle the word underneath the flower, just the flower, or both. What is most important is that they select the response that best describes them.

6. Let students take the survey.

\*\*We found that it was better to let students read the questions on their own and answer accordingly. Let students know if they have a question to raise their hand and you will help explain the question. However, if you think it would be best to read each statement to the students please do so. Listed on the back page are some statements that were confusing to students in our pilot test. I have provided some examples to help you explain the statements to your students should the need arise. If you have a more appropriate example to help explain this statement or any other problem statement(s), please feel free to use your explanation.

7. Collect surveys. Mail consent forms and completed teacher and student surveys in the enclosed envelope by April 14.

THANK YOU!!

APPENDIX E  
SAMPLE PROBLEM QUESTIONS AND EXAMPLES

SAMPLE RESPONSES

Here are the statements that gave some students in the pilot test problems:

**#2 – I do my best even when it is a job I do not like to do.**

Example to give students:

You do your best at cleaning up your room even when you don't really want to clean it.

**#25 – I think people should try to recycle.**

Example to give students:

Define recycling – using something more than once, like making old soda cans into new soda cans.

**#27 – I think people should stop air pollution.**

Define air pollution – air pollution is when people make the air dirty by putting bad stuff into it, like chemicals and smoke – they make the air dirty.

**# 29 – I think people must take care of the environment.**

Define environment – the earth, nature, all the animals and trees, oceans, air.

**#30 – I think people should stop water pollution.**

Define water pollution – water pollution is when people put bad stuff into the water like chemicals or trash – they make the water dirty.

**APPENDIX F**  
**CORRELATION STATISTICS OF TYPOLOGY FACTORS**

Table F-1. Correlation statistics for typology factors.

Variable	1	2	3	4	5	6	7
1. Number of activities students participate in prior to and while in the garden.	1						
2. Percent of time the garden is used as an instructional tool in the classroom.	.218*	1					
3. Number of hours per week students spend in the garden.	.276*	.348*	1				
4. Number of Science Sunshine State Standards addressed through use of the garden.	.172*	.220*	.311*	1			
5. Number of subject areas into which the garden has been incorporated.	.651*	.105**	.243*	.216*	1		
6. Number of sources and types of material used to support the garden in the curriculum.	.647*	.369*	.440*	.274*	.689*	1	
7. Number of years the garden has been a part of your curriculum.	.311*	.291*	.396*	.952*	.235*	.295*	1

\* = significant at  $p = .000$  \*\* = significant at  $p < .05$

# APPENDIX G ANCOVA STATISTICS FOR TYPOLOGY FACTORS

Table G-1. ANCOVA statistics for typology factors.

Factor	R	SA	US	EA	GA
No. of hours per week students spend in the garden.	$F = .236$	$F = 2.85^*$	$F = 2.07$	$F = 2.29^*$	$F = 6.08^{**}$
Percent of time the garden is used as an instructional tool in the classroom.	$F = 1.48$	$F = 6.44^{**}$	$F = 8.12^{**}$	$F = 1.37$	$F = 14.42^{**}$
No. of subject areas into which the garden has been incorporated.	$F = 2.28^*$	$F = 2.35^*$	$F = 6.76^{**}$	$F = 1.61$	$F = 9.98^{**}$
No. of years the garden has been a part of your curriculum.	$F = .563$	$F = 5.05^{**}$	$F = 4.65^{**}$	$F = 2.73^*$	$F = 13.29^{**}$
No. of sources and types of material used to support the garden in the curriculum.	$F = 1.32$	$F = 2.07^*$	$F = 3.82^{**}$	$F = 1.42$	$F = 12.19^{**}$
No. of Science Sunshine State Standards addressed through use of the garden.	$F = .629$	$F = 5.73^{**}$	$F = 7.35^{**}$	$F = 2.31^*$	$F = 8.95^{**}$

R = Responsibility; SA = Science Attitudes; US = Usefulness of Science Attitudes;

EA = Environmental Attitudes; GA = Garden Attitudes

\*  $p < .05$  \*\* $p = .000$

### BIOGRAPHICAL SKETCH

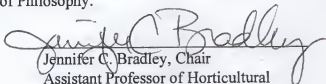
Sonja Marie Skelly was born in Houston, Texas on April 16, 1971. Sonja grew up the oldest of three children living in Seabrook, a small coastal town outside of Houston. Sonja's love of plants came from her grandparents who were avid gardeners. They taught her how to grow plants and appreciate nature. Sonja's parents instilled in her a desire to do well in school and always encouraged her to pursue her dreams. Sonja graduated from Clear Lake High School in 1989.

After graduation, Sonja attended Texas A&M University, where she earned a Bachelor of Arts degree in Anthropology in August 1994. During her undergraduate career, Sonja began working for Dr. Gretchen Jones, a research scientist with the USDA. Dr. Jones encouraged Sonja to pursue her goal of going to graduate school. With her background in Anthropology and her desire to work with plants, Sonja was invited by Dr. Jayne Zajicek to enter graduate school in the Department of Horticultural Sciences at Texas A&M University. Dr. Zajicek was researching projects in the area of Human Issues in Horticulture and suggested that Sonja begin a research project in this area. Sonja chose to work with schoolteachers to research the effect of their gardens on the environmental attitudes of their students. Sonja received her master's degree from Texas A&M University in December 1997.


In August 1997, Sonja began working with Dr. Jennifer C. Bradley at the University of Florida. She continued her research with school gardens to complete

her Ph.D. After graduating, Sonja plans to pursue a career in horticulture and to continue assessing the benefits of plants to people.


I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

  
Jennifer C. Bradley, Chair  
Assistant Professor of Horticultural  
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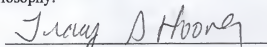
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